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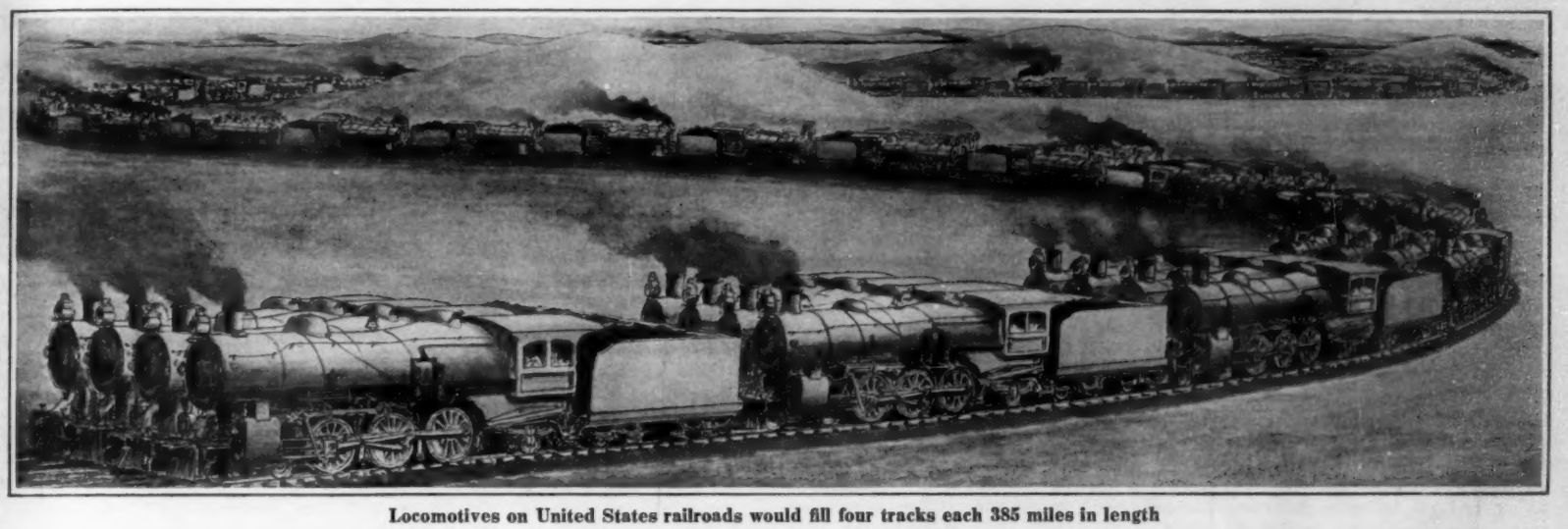


Locomotives on United States railroads would fill four tracks each 385 miles in length

The United States Railway System

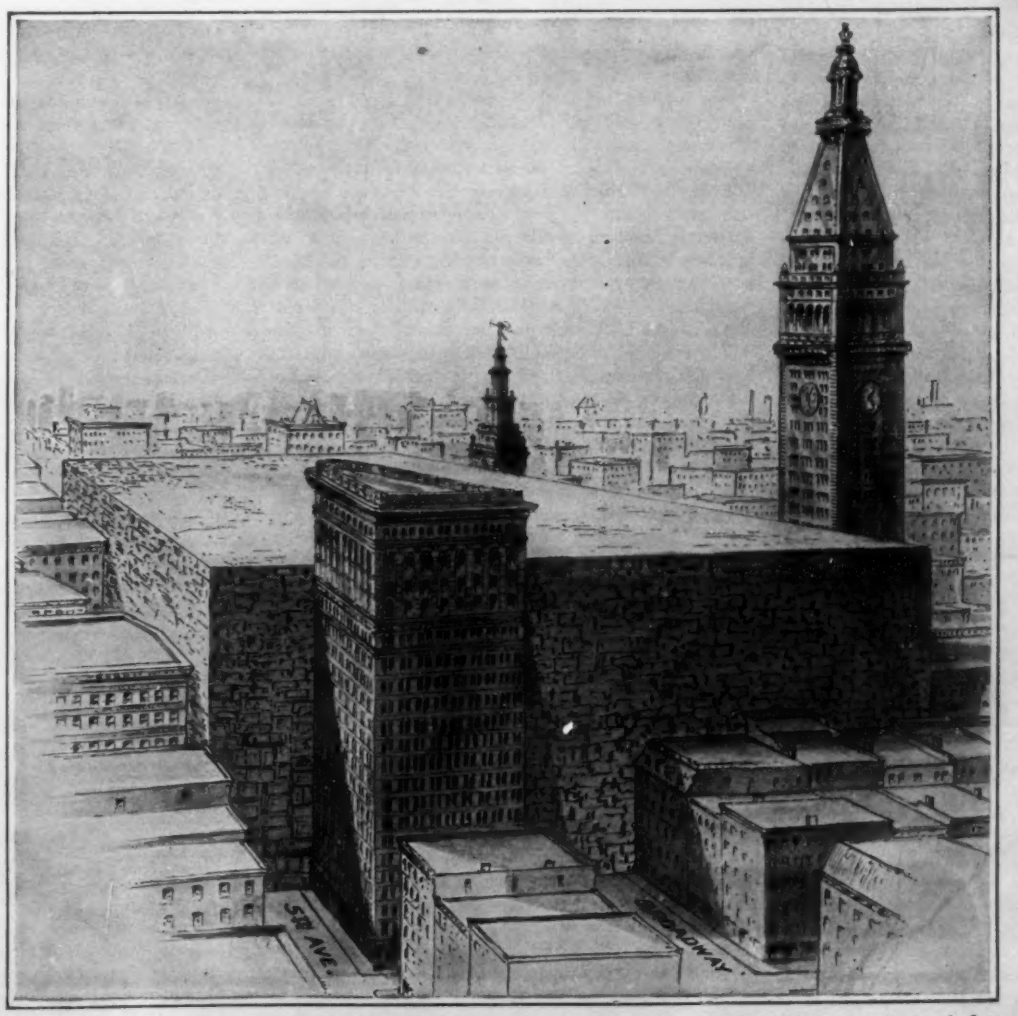
EVERY one of us knows that the railway system of the United States has the quality of bigness, but not every one understands just how immense it actually is. Naked figures are not always convincing. We need standards of measurement—something small and familiar which we can multiply into terms of something vastly greater with which we have no day-by-day familiarity.

An instance of this is found in that great transportation problem, which is causing so much anxiety just now to the general public. Any railroad man, especially if he has had to do with the larger operating movements, will understand at once that when Secretary McAdoo took over the control of all the railroads of this country, he was assuming the managership of the biggest system of transportation on earth; but not many people are aware that the railroads of the United States have a total length approximately equal to those of Europe and Asia combined. As a matter of fact, the railroad tracks, if strung out in a continuous line, would be sufficient to run a girdle of steel eleven times around this earth at the Equator.

Equally startling are the figures showing the total equipment of locomotives and cars and the total amount of frieght that is handled by our railroads. Thus, if we take the average length of a locomotive as being 125 feet, we find that the 65,000 locomotives which are possessed by all the railroads, if they were placed end to end, would fill four railroad tracks each 385 miles in length.

The freight car statistics give us some remarkable figures. The average length of a freight car is about forty feet overall, and if the cars on all our railroads were placed end to end, they would stretch continuously for 20,000 miles, which means that there are sufficient cars in the United States today, if strung out, to make a complete circle of the earth along the latitude of Philadelphia.

The amount of freight that is carried every year is stupendous. The tonnage last year was 1,802,018,117 tons. That is a big total, and in order to visualize its bulk let us invent some large receptacle and see how many times it would have to be filled to measure out nearly two billion tons of freight. For a measure, we will take Madison Square, New York city; which extends 870 feet by 570 feet from building to building. Assuming that the average content for each ton of freight is 50 cubic feet, we find that on the basis of nearly 2,000,000,000 tons of freight per year we would have to fill Madison Square every 12 hours of the year to a depth of 279 feet. That is to say, we would have to keep on filling Madison Square from the first day of January to the last day of December, twice a day, in order to measure out the total yearly tonnage moved by our railroads.



Freight handled by our railroads would fill Madison Square, New York, to a height of 279 feet, twice each day

Finally, as regards the financial aspects of our railroad system, it may be mentioned that the total operating revenues for the fiscal year ending June 30th, 1917, were $3,824,000,000; the total operating expenses were $2,581,000,000, and the total net income was $1,069,000,000.

An Oil-Cleaning Machine Based on the Milk Separator Principle

AN oil-cleaning separator has recently been introduced in the Swedish market by a local company. Great quantities of oil go to waste in manufacturing and other establishments, which if cleaned could be used again. The separator frees the oil from all foreign matter and makes it ready for use again. The separator resembles the old milk separators and can be operated either by hand or electricity. Two kinds are being manufactured, the one cleaning 150 and the other about 250 liters an hour. The oil separators are already in use in many large factories on the Continent and will be used largely in British munition factories.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

"The Freedom of the Seas"

CONSPICUOUS among the many catch-words and formulas which Germany has sprinkled freely throughout her written and spoken propaganda is the ever-recurring phrase, "The Freedom of the Seas." It is the most fair and seemly child in a litter which includes many another specious offspring of German camouflage and cunning.

There has been much speculation as to what Germany means when she talks of the freedom of the seas. Had the phrase been coined several centuries ago, when the pirate and the freebooter infested the thoroughfares of the sea, it would have been full of meaning and very timely; but we thought it had been understood for centuries past that the seas were free to all who chose to come and go upon them. This freedom was permanently established when the black flag was swept from the seas. The records of the British, French and American Navies reveal that everywhere and at all times they have stood ready to hunt down and destroy piracy and all forms of maritime lawlessness. This suppression of piracy is an old, old story; and for at least a century the ships of commerce have been free to come and go when and where they would. It was under this strong protection that Germany was able to build up that great merchant fleet which was one of her proudest possessions at the opening of the war; and during the long years of its growth there has not been a single port of the British Empire which was not open to ships that flew the German flag.

What is it, then, that the Germans are seeking when they clamor for the freedom of the seas? Do they wish for a return to that age of lawlessness when the ships of the black flag, if they possessed the speed, the guns and the fighting crew, were free to seize and sink without trace ("spurlos versenken") such craft as chance might throw in their way? Without doubt that is the freedom which Germany is exercising today—a freedom of brute force; a self-granted freedom to violate the long-established principles of maritime law. She wishes for the same freedom from civilized restraint on the sea as she has shown throughout forty months' of warfare upon land, where she has not only broken the laws of civilization as they operate in the normal times of peace, but has violated every one of those humanitarian laws, with which men have endeavored to mitigate the pain and loss entailed upon the non-combatant population of such countries as may find themselves at war. Whatever Germany may mean by the "freedom of the seas," she is revealing upon the high seas today, a freedom from the restraints of civilization and the elementary dictates of humanity, which is appalling in its cold-blooded ferocity.

It is possible, of course, that the blockade of her ports and the internment of her fleet have raised the question in her mind as to whether it will not be possible in the peace negotiations, whenever they arrive, to secure some restrictions under which the Allied fleets can never exercise, in any future war, such a command of the seas as they now hold. But if Germany should be able to develop her naval power to the point at which she herself could obtain such a command of the sea as is now held by her opponents, she would impose that command with characteristic ruthlessness, cruelty and disregard of every written and spoken pledge.

No, the freedom of the seas exists and has been in force for many a century gone by. There is only one freedom of the seas to be won, and it will be won, not by Germany, but by that grand alliance of civilization which confronts her today. It will consist in a freedom from any such riot of murder and brutality as Germany is now perpetrating in her ruthless submarine warfare against peaceful shipping. When she has been thoroughly beaten, the Allies will see to it that the innate ferocity of the German military character shall never again have the chance to express itself through unrestricted submarine attack. A provision to this effect will be embodied in the peace terms, to which the democratic leaders of a thoroughly beaten Germany will sign their names.

Academic Freedom Again

WE publish in our Correspondence Column an interesting letter from one of our readers, protesting against an editorial appearing in the SCIENTIFIC AMERICAN of December 15th, entitled "Academic Freedom." The writer of this letter takes the position that the action of Columbia University in separating from its curriculum influences which it considered harmful to the standing and position of the University is a direct interference with liberty of speech.

This whole question of freedom of speech is one which has been discussed pro and con in the daily press for some time, but, it would seem, without a full realization of the aims and purposes of a university. We believe that our correspondent has fallen into the same error which has shown itself so often in various communications which have appeared from time to time, and if allowed to pass unrefuted will tend to weaken our entire educational system. It is very doubtful whether such a discussion of facts would have arisen a generation ago; but with different times come different customs, and until our universities have taken some definite stand as to the policy which they intend to pursue this discussion will continue and increase. We doubt whether even our correspondent would contend that under the guise of freedom of speech our university professors should be allowed during these times of war to preach doctrines which are traitorous to the cause which our great Republic has pledged itself to carry through, no matter in how insidious a form these precepts of disintegration are put forward.

There was a time when our college professors were selected as much for their high moral character and standing as for their intellectual gifts, and we believe that such a process of selection should be and still is carried out in our colleges and universities. Our correspondent does not seem to realize that we are living in an age of intense agitation. Often this agitation is actuated by conscientious motives, but much of it originates from a spirit not of construction but destruction. Many of the doctrines of discontent which are being put forward at the present time are the result of an organized system with various purposes in view. Some are intended to produce class feeling, some to produce a social upheaval, some arise through a childish love of change whatever that change may be, some from a pure spirit of mischief or excitement, and some from the iconoclastic spirit of the anarchist. We have seen the results of these methods carried out by the organized efforts of the I. W. W. and their brethren in Russia under the name of the "Bolsheviki." Most of these agitations arise from the inherent greed and jealousy of human nature and a desire to enjoy a neighbor's property, with the alluring prospect of trying to acquire something for nothing.

Our country has absorbed during the past few decades many turbulent spirits who have no appreciation of what our aims and purposes really are, whose moral obligations and point of view are different from ours, and who are in many cases either fanatics or enemies of our institutions. No proper discussion of the subject of academic freedom of thought can be brought forward without bearing these unfortunate facts in mind. Destructive thought is being organized into a trust and reduced to a system, as those who come in contact with the discontented in any phase of life only too well know.

The function of our colleges and universities is, in the first place to educate the young in various fields of learning; not only this, but to build up the moral character of the individual. During the impressionable age at which our youth go to college nothing could be more unfortunate than to introduce disputations in place of education. The foundation must be well built and laid upon the deepest fundamentals or the superstructure will continue to be shaky and unstable all through life.

Our universities in this country in the main have had a splendid record; they have broadened; they are up to the times; new educational methods have been introduced, the curriculum has been improved. Their material and physical aspects have grown in an unprecedented way, and the approval which is felt by those who are able to enjoy the advantages of a college education is proved by the enormous development of these institutions. Growth and change will continue to be in order, and from time to time will be realized. But it is not the function of the teaching corps to agitate for change before or through the student body. When a member of the faculty feels that a certain change in the program or the aims or the institutions of his university is called for, the proper avenue through which he can and should push his demand for that reform is through his colleagues and his trustees. Discussion and agitation in these channels is highly proper. But the college and university classroom must not be mistaken for a mere forensic forum. If this condition should be reached the usefulness of these institutions as educational factors would come to an end.

Furthermore, it should be borne in mind that in some of our colleges the students have a very direct and positive part to play in the governing of the institution. In many institutions the trustees, or part of the trustees, are elected by the graduate students. In Princeton University, where the honor system has been for many years an established fact, the disciplining of students is left in the hands of the student body, and members are tried and punished by the judgment of their peers. When discipline is meted out the decree of the tribunal is submitted to the faculty, which merely confirms the ruling of the student court.

It would appear that our colleges should be made to stand in the eyes of the public for certain well-defined principles; that the professors should be selected with a view of maintaining and carrying out those principles. Before accepting a chair in one of those institutions such professors should be willing to subscribe to the tenets which the university represents. If after accepting a chair with that clear understanding in view a professor grows out of harmony with the work which the university is carrying on, he should withdraw from the institution, as his usefulness has come to an end.

The students may select their university according to their taste. There is no such thing as compulsory service, as far as our colleges or universities are concerned. It is a question of free election. The trustees of our universities are almost invariably graduates of the institution which they govern, who understand the spirit and aims of that institution, and are concerned alone with its growth and prosperity. They and the faculty would be the very first to discover weaknesses in the educational system, and devise methods to correct those weaknesses. The governing of these bodies of young men can safely be left in their hands.

Creatures that Live in Snow

SNOW has both a flora and a fauna. The flora includes the tiny organisms of the seaweed family which commonly produce the phenomenon of "red snow." Each of these "plants" is a spherical cell, about a thousandth of an inch in diameter. These cells multiply rapidly by the simple process of splitting up to form new cells, and the latter are at first equipped with whip-like appendages which enable them to swim in water. Red snow is not uncommon in the polar regions and on high mountains. Large tracts of "green snow," produced by another minute plant, were found by the Charcot antarctic expedition.

But there are also humble forms of animal life that give snow a red color. Patches of snow reddened with a microscopic rotifer, or wheel-animalcule, have been found in the Alps and the Andes. M. Gain, of the Charcot expedition, found snow reddened with mites or tiny spiders.

In Germany the term "snow worm" is applied to the larva of a beetle often found in the snow. Many species of insect are commonly found on glaciers. The most abundant of these are the springtails, which hop like miniature fleas or wriggle deftly into the cavities of the snow, but are so minute that the passer-by needs to look for them in order to see them. Occasionally, in their jumps, they light in a puddle of water, but this experience does them no harm, as they are thickly clothed in furry scales which save them from getting wet. Snow-loving springtails are not confined to glaciers; they occur in great numbers on the surface of melting snow, on bright sunny spring days, through the northern United States.

Mr. F. E. Matthes, of the U. S. Geological Survey, has recently described some curious worms that abound on the lower parts of the Mount Rainer glaciers. They are dark brown, slender and about an inch in length. On favorable days in July and August millions and millions of them may be found, writhing on the surface of the ice, evidently breeding there and feeding on organic matter blown upon the glacier in the form of dust. "So essential to their existence," says Mr. Matthes, "is the chill of the ice that they enter several inches, and sometimes many feet, below the surface on days when the sun is particularly hot; reappearing late in the afternoon."

Infantile Paralysis in Cold Weather

AN outbreak of poliomyelitis which occurred in West Virginia in the winter of 1916–17 served to correct the impression which has prevailed that this dread disease is confined to the warm season. According to Dr. J. P. Leake, of the U. S. Public Health Service, other winter outbreaks have occurred in the United States, though the recent one was the first to assume anything like epidemic proportions. Winter outbreaks have also occurred in Sweden, Norway, Germany and Austria. Dr. Leake has examined the statistics of the weather prevailing at the time and place of each winter outbreak on record. Some of these occurred far north of the Arctic Circle. In some the thermometer remained below freezing during practically the entire time of the outbreak, and in 15 outbreaks the temperature fell below zero Fahrenheit. In one instance, at Misvar, Norway, it fell to 29 below.

Engineering

Removing a Hill to Ventilate a City.—The location of the City of Rio de Janiero, Brazil, is such that it is cut off from cool winds by an elevation known as Costello Hill. For a hundred years or more it has been proposed that this obstruction be removed, and now a syndicate has been formed which has applied to the Government for permission to level the hill, using the material removed to reclaim a large area of submerged land. The work will involve the removal of 47,000,000 cubic yards and it is estimated that the cost will be $10,000,000.

Water Supply Siphon Across the Narrows of New York Harbor.—The waters of the Catskill Aqueduct are conducted to Staten Island through a 36-inch pipe that runs across the Narrows of New York Harbor from the Brooklyn shore. This pipe line is 10,300 feet in length. The pipe sections are connected with flexible joints and the joining of the sections was done on the surface, the pipe being guided by a cradle from a barge into a shallow trench dredged in the bottom of the Bay. A careful test was made of each joint while the pipe sections were being connected, and since then hydrostatic tests have been made of the pipes line, as a whole to determine the amount of leakage. Under service pressure varying from one hundred to one hundred and ten pounds per square inch the line showed a leakage of only 0.78 gallon per minute over a period of 40 days.

Fighting Culebra Slides.—In the report of the Panama Canal for the fiscal year 1916-17 Governor Chester Hardy states that the East Culebra Slide is still in motion with occasional periods of increased activity, each period resulting in a settlement of the entire mass within the limiting break, and a horizontal motion toward the center of the bowl-shaped area. The east bank of the canal has been excavated several hundred feet beyond the limits of the canal prison so that the movements of the slide do not produce upheavals of the bottom within the limits of the canal prison. After each movement the dredges excavate the material outside the canal limits and have no difficulty in keeping it from reaching the channel. Altogether 23,259,909 cubic yards of material have been removed by dredges from the Culebra slides and it is estimated that 36,000,000 yards must yet be removed.

Toothless Metal Saws in Germany.—Quickly revolving smooth steel disks are now being used in Germany for cutting metals with, it is stated, results equally good and even better than those obtained by toothed saws. The actual cutting is not effected, as was formerly understood, by removing the metal, but by the heat generated by the friction between the rapidly revolving disk and the metal. That heat is so great that the metal is melted at the point of contact. The disk has consequently only to discard the molten metal, and by doing so clears the dividing groove. Naturally the steel disk also becomes heated in the operation, but as the greater part of its circumference is always out of contact, and continuously being cooled by air, and as the friction for each point of the disk circumference only lasts for a minute fraction of a second, its own heat remains always below melting point. When that fact was realized, toothless saws were soon constructed which were able to cut through all metals, even the strongest joists, in a minimum of time. The advantages over the toothed metal saws are that the disks do not wear out so quickly.

Life of Water Pipe in Buildings.—To determine the life of water pipe in buildings under varying conditions of service, a canvass was recently made in Pittsburgh of 125 apartment buildings. The investigation showed the corrosion to be most severe in hot water mains (exposed basement piping) and the recommendation is that pipe one size larger than that used in regular practice be used. The point is that the larger size, having a greater thickness and larger bore, would not so easily rust through or become stopped up with rust. The hot water risers, which are usually concealed proved to have much longer life than the basement mains. It is therefore a question whether the practice of specifying brass pipe for risers, and iron or steel for mains, might not better be reversed. Brass pipe in this investigation did not show up as well as might be expected. Genuine wrought-iron pipe, in 65 buildings, ranging in age eight to twenty years, did not show a single failure when used for cold water supply, and in only one or two of these buildings did the iron hot water risers require repairs in the same period of time. Lead pipe, for hot water risers, seemed to have an average life of eighteen years, one complete failure being recorded after fourteen years' service. It appeared from the investigation that the pipe lasted a little longer where an automatic water heater was used. This is regarded as due to the possibility that a lower temperature of the water is maintained than with a heater without thermostatic control, corrosion increasing with temperature and reaching its maximum between 140 and 170 degress Fahr. Temperatures from 115 to 130 degrees are recommended wherever they will serve the purpose.

Astronomy

The Bruce Medal of the Astronomical Society of the Pacific will not be awarded for the year 1917, on account of the international situation.

Astronomers in War Work.—Several well-known astronomers, especially on the Pacific coast, are giving instruction in the new Navigation Schools established by the U. S. Shipping Board. This work in the west is under the general direction of Prof. A. O. Leuschner, director of the astronomical department of the University of California.

Cold Weather on Mars and the Earth.—During the 1916 opposition of Mars the northern snow cap of that planet extended about one hundred and eighty-five miles farther south than in the previous opposition. In reporting this observation Prof. W. H. Pickering suggested that it would be interesting to see whether a cold winter on Mars would be followed by a cold winter on earth. Apparently this was the case, as the winter of 1916-17 seems to have been considerably colder than the average in both Europe and America.

Solar Activity has been exceptionally great during the past year. In February, 1917, the disturbance of the solar surface was more extensive than any observed during the eleven years previous, comprising two vast sunspots connected by a network of fainter markings. According to the last report of the Solar Section of the British Astronomical Association, the entire spotted area of the disk on August 10th and 11th exceeded that on any previous day since the photographic record of the solar surface was commenced at Greenwich Observatory.

The Radioactivity of Meteorites, a subject hitherto almost completely neglected, is discussed by Messrs. J. T. Quirke and L. Finkelstein in a recent number of the *American Journal of Science*. The writers determined by an ingenious method of analysis the radium content of 22 meteorites of various types, furnished by the Field Museum of Natural History. The results appear to show that the average stony meteorite is considerably less radioactive than the average igneous rock, and probably less than one-fourth as radioactive as an average granite; also that metallic meteorites are almost free from radioactivity.

The Ring Nebula in Lyra.—This object, well known to all who use the telescope, was photographed 14 times during the year ending August, 1917, with the 60-inch reflector of the Mt. Wilson observatory, in order to secure plates suitable for a determination of its parallax. The exposures were of from twenty-five to thirty minutes and excellent results were obtained. The measurements and reductions give an absolute parallax of +.004 second. On the basis of this parallax the major axis of the nebula is 330, and the minor axis 250, times the diameter of the orbit of Neptune; in other words, the nebula is about three hundred times as big, in linear dimensions, as our solar system. However, parallaxes of this order of magnitude are decidedly uncertain.

Mars will be in opposition March 14th, 1918, and the students of this planet have been observing it regularly since October. As at previous oppositions, Prof. W. H. Pickering, located at Mandeville, Jamaica, is acting as a clearing-house of information concerning the ruddy planet, and he is continuing his plan of collecting drawings made by observers in this country and abroad. Details are given in *Popular Astronomy* for November. The maximum diameter of the planet at this opposition will be a little more than fourteen seconds. Mars reaches its summer solstice March 24th, 1918, but six days after its nearest approach to the earth, and will therefore be unusually well placed for observations of its northern latitudes. Prof. Pickering predicts that the canals will reach their maximum number at the present opposition, but that they will be finer and more delicate than usual and hence the best of seeing will be required to draw them satisfactorily. A special effort will be made to settle the mooted question of the shifting of canals over the Martian surface.

The International Observations for the Variation of Latitude, inaugurated in 1899 under the auspices of the International Geodetic Association, are being continued, in spite of the war, at Ukiah, California, Carloforte, Italy; Mizusawa, Japan, and; probably, Tschardjui, Russia. The period for which the Association was organized under official international agreement expired at the end of the year 1916; while the death of two members of the executive committee, Backlund and Bassot, and the illness of a third, Helmert, left as the only active member of the committee Prof. H. G. van de Sande Bakhuyzen. This member has arranged for a provisional continuation of the work, for a period to end two years after the close of the war, through the coöperation of the governments of Denmark, Netherlands, Norway, Spain, Sweden, Switzerland, and the United States. A new executive committee has been formed, with Prof. Raoul Gautier, of the University of Geneva, as president and Prof. Bakhuyzen as secretary.

Aeronautical

The Nieuport Chaser.—During 1916 and 1917 the Allies made extensive use of the Nieuport biplane for scout work, and although faster machines have now made their appearance, this model is still holding its own to some extent. The wing spread of the standard Nieuport biplane is 24 feet 8 inches. The planes, while both of the same length, are not of the same width, the bottom plane being only half as wide as the top. Furthermore, the wings are staggered. The wings are connected by a V-type strut, which form of construction was characteristic of the Nieuport until the Germans began to copy it. The power plant is a 80-horsepower Le Rhone rotary engine, enclosed in a circular cowl. A later model is equipped either with a 110-horse-power Le Rhone or a 130 horse-power Clerget engine. The machine when fully loaded weighs 1,210 pounds.

The Sopwith Triplane.—Among recent fighting craft of the British is the Sopwith triplane which, it will be recalled, was greatly praised by the German commander facing the British. Now that details are available concerning this type, it appears that the triplane design is used because it permits a minimum of wing spread. In the Sopwith triplane fighter the wing spread is 8 meters, and the total wing surface 27 square meters. The weight of the craft, fully loaded, is about 670 kilos. The triplane has a small dihedral, but no arrow shape of the planes. The body carries a 110-horse-power Clerget rotary engine in front, housed in a round cowl, overhanging the body for the purpose of diverting the air. The Sopwith triplane is turned out both as a single-seater and as a two-seater. It is always armed with a fixed gun in front, and in the case of the two-seater, with an additional turnable gun for the observer. The two-seater triplane weighs about 100 kilograms more than the single-seater.

Stranger than Fiction.—The special correspondent of the *Petit Parisien* on the British front has a story obtained from a German prisoner which reads like a juvenile novel. It appears that an English aviator, descending from the sky, landed gently near a Boche sentinel. The aviator asked him in purest German where the officer in command of the Gothas was to be found, saying that he had an urgent message for him. The sentry replied: "The Herr Commandant of the Gothas lives where the Gothas are, but the Herr Lieutenant knows that." To which the aviator replied: "Yes, my lad, but in the fog I have missed my way and now I am lost." Answered the sentry: "Ah, yes. I know the same thing happened the other day to Herr von Schultz, my captain," following which, and with the greatest of deference, he gave directions as to how to get to the Gothas. The aviator had hardly taken to flight again when the sentinel noticed to his horror the British marking on the planes!

What the Germans think of the Spad.—Commenting on a captured Spad machine, the *Deutsche Luftfahrer Zeitschrift* has the following to say: "In a way worthy of being taken for a model the motor is enclosed completelv, disappearing in the exemplary formed body. So one has to pronounce and recognize this new construction in the field of single-seater scouts as very excellently designed, throwing all former results of our enemies far in the shadow, especially owing to the exceptional large attention to rigid solidness of the whole structure. The German aircraft industry shall learn much from this airplane type and become incited to many new ideas in design. Just as our enemies equipped last year in the big spring offensive an exceptional number of their air service with the Nieuport biplane, so they did this year with the Spad scout. Our aircraft industry have too worked during the winter on new types that shall, be it hoped, get an equal recognition to that which we cannot refuse this airplane."

The Day of the Bombing Plane.—Interviewed recently by the French publication *L'Auto*, Signor Caproni stated that he is about to try to cross the Atlantic in one of his triple motor machines. In laying stress on the advantage of using big airplanes for bombing, he pointed out the difficulty he had experienced in getting his ideas adopted. He said that the enemy, helped by their large supplies of labor, had been working with tremendous energy, and produced Gothas and Zeppelins with incredible rapidity. Next spring, he thought, we would see a remarkable blossoming forth of the Austro-German effort. The rear will suffer equally with the front. Paris, Lyons, Le Creusot, St. Etienne and St. Chamond will be bombed with a frequency that we do not dream of now. And in the same way the Allies will carry death and desolation into the enemy's country. But they ought not to lose a single minute. It is aviation which will bring the war to an end. Victory will go to that one of the belligerents who first perfects his aerial army. We must therefore speed up our production. The enemy is on our heels, and making tremendous efforts to gain the mastery of the air, without which victory in modern warfare is nothing but a myth.

The Women Workers of Canada

Personal Experiences in a Canadian Rifle Factory

By Mary J. Huestis

SHORTLY after war was declared, the Daughters of the Empire of Quebec, Canada, a patriotic and educational organization, volunteered their services as munition workers.

The women of England were our inspiration. We read of their sacrifice to do men's work, thus releasing the men for war duty, while they kept the wheels of national industry in motion. We believed that what the women of England could for do their country, for the world's liberty, we, the women of Canda, could do. And so we volunteered for war service to the Ross Rifle Company, at Quebec, makers of the National Canadian Service Arm, and our offer to assist as machine operators was accepted by the President, Sir Charles Ross, with the understanding that we would receive the same rate of pay as the men.

Some of us believed we were not fitted for factory work, but we did not want to discourage this great wave of patriotic enthusiasm that swept over our women who wanted to do their bit—hands-across-the-sea with their English sisters, in unity of purpose. Speaking of women not fitted for factory work, I counted myself the first mechanical failure. I remember laying awake all night before starting work as a machine operator, thinking up some scheme for hiding my failure before public criticism, and near daylight fell asleep repeating the word "slacker."

The morning we started for work a Quebec blizzard was raging, the thermometer being 22 below, and we had to cross the historic Plains of Abraham to get to the factory. I shall never forget my first lessons as a machine operator—war work that made you actually feel you were in sight of the firing line.

We started work in the Machine Barrel Straightening Department. The ten working hours a day were divided in two five-hour shifts. Operators working in the morning one week changed to the afternoon shift the next week. Barrel straightening by machine was a new departure in rifle manufacture. Generally barrel straightening is done entirely by the hammer and block method. Machine barrel straightening requires great precision, and although working with our hands we were mentally registering so many pounds pressure to the inch every time a machine hammer struck the barrel to straighten it. In this capacity an operator lifted on an average 1.14 tons per hour.

When I was for the first time given charge of a small group of women, although appreciating my promotion I did not, however, like the idea of standing around letting others do the work, but before the first shift was over in my new job, I realized it was not all standing around. Two big problems confronted me. I was there for war work, but I must learn something of the manufacturing end before I could see success ahead of us. Being at that time on the five-hours shift, I devoted the other five hours of the day to the study of the manufacturing and executive end, and after several months' study I was promoted to supervisor of the Machine Barrel Straightening Department. In this capacity, I was responsible for the output and class of work in this department, and the conscientious work, fineness of touch, and precision of our women operators soon proved that they were fully able to meet the requirements.

Later on, the Women's Employment Bureau was under my direction, and my final promotion was Superintendent of Women. The very shortest possible time which a woman must remain in the machine operator class before she can be eligible for promotion to executive posts of any kind, is six months. The psychology of the six months period of training comes in disciplining women to accustom themselves to the routine and discipline of factory life, which, in turn, they have to impress upon their subordinates.

Our next supplementary work was in the Bayonet Department. The work in this department is not of one character, as in the Machine Barrel Straightening Department. It consists of milling, profiling, drilling, punch press, etc., and in this department our women also did expert work, setting up the machines after an incredibly short space of time.

As emergency required, we drafted women to supplement the work in other departments, where they learned to operate lathes, screw machines, cutters, grinders, etc. Women were also introduced into the inspection and assembly departments.

Machine barrel straightening was our pioneer department and from here you can trace in the factory records, expert operators in nearly every department. Three of our best barrel straightener swere instructed in rifling, and proved expert operators. *These are the first and only* women riflers on the continent of America. Rifling and machine barrel straightening (a new departure) were the only operations taught in schools, being of an exceptionally difficult nature. All other operations were taught in the shop. Machine barrel straightening was the only department with a five-hour shift. In all other departments we worked ten hours.

Welfare Department. In order to study the best methods of welfare work my assistant and I visited the National Cash Register plant, Dayton, Ohio, where they seem to have thought out the right way to do everything. Then we studied the Omar plant at Dayton, manufacturing fuse for the Russian Government. Here again was a model plant adaptable to war conditions. We also visited Peters Cartridge factory, King's Mills and Ford's at Detroit—each offering the very best suggestions. I drafted from each that which was best suited to our conditions. We had our trained nurse, our rest rooms, restaurant, doctor, etc. Service badges for munitions workers were a great incentive to make them come regularly to work, as badges were given for good work, good conduct and regularity, and a worker had to be at least three months in the factory to get one.

Our Welfare Department spelled promotion for our operators. No person can be fitted for executive control, and hold respect of his subordinates, unless he is able to give practical demonstrations. It follows, that all women entering a factory should begin as machine operators, and go through routine work in order to be in touch with employer and employee—team play being the only road to success in the plant. All distinction as to class, race, language were levelled and not recognized. We had as operators women of all classes from the daughters of the General Manager down.

Women at work in the bayonet department

Women experts in the rifling school

The grinding department

Mrs. Huestis in official working costume

The bayonet department

Substitutes for Brass Bearings

THE very high price of copper, brass, zinc and tin resulting from the war has taxed the ingenuity of both men and nations to find substitutes. Many combinations have been made with lead, iron and other metals to bring down the cost, and there has been a considerable increase in the use of cast iron for bearings. This metal makes an excellent bearing if it is well fitted and has sufficient area, but once it begins to grip at any ill-fitted part, much mischief may be caused in a very short time.

Metal is far from being the only material for bearings. Various hard woods have been successfully used for the purpose notably in the case of screw propeller shafts These have for many years been made of lignum vitae, which grows principally in the West Indian Islands; but increasing demands have rendered it so scarce that substitutes for this substitute had to be sought. The Philippine Islands are famous for the quality and variety of their hard woods, and of these the mancono is reported to be the best and most durable. The following is a comparison between lignum vitae and mancono:

Lignum vitae (*guaiacum officinale*) is greenish brown and the sapwood is a bright yellowish color. Its specific gravity varies from 1.17 to 1.39. The grain is fine and the wood fibers small and exceedingly twisted, thus making it a very difficult wood to split.

Mancono (*Xanhostemon verdergonianus*) has a brownish heartwood that turns purple when exposed to the air: the sapwood is narrow and of a pale reddish color. The wood weighs from 77 to 90 pounds per cubic foot or 44 per cent more than water. Compared with teak it is just double the weight. Tests have been made of this timber that show it impervious to decay, and proof as well against the white and the teredo, or sea worm. An official test was made with it in the stern tube of a steam launch in constant use, and after seven months it was withdrawn and the commander of the naval station reported it to be quite equal to lignum vitae, when used for the same purpose.

There seems to be an opening for mancono amongst ginning factories, both as bearings for the shafting and for the connecting rods of gins. They might be made in any speed lathe with the aid of a small circular saw and a revolving cutter. A comparison may be made of the friction of hardwood bearings with those of brass from the table published by Trautwine representing the co-efficients of moving friction of a smooth plane surface when kept perfectly lubricated: Wrought iron on brass lubricated with olive oil, 0.078; wrought iron on elm, 0.078. It is probable that mancono would have about the same friction co-efficient but would be more durable on account of its resemblance to lignum vitae. The durability of wooden bearings depends to a great extent upon the smoothness of the metal in contact with them, and thus the metal should be carefully smoothed. In shafting an extra allowance of length might be made in view of the inferior hardness of the wood as compared with brass. With brass castings at such high prices it would be well worth the trouble to factory owners to experiment with wooden bearings, and begin with the hardwoods of the country that is nearest to them. India supplies a number of hardwoods, including babul and the various iron woods found in the jungles.

A backward pull makes the animal far-sighted

Pulling the string forward produces near-sightedness

A pull at right angles to the eyeball causes astigmatic vision

By pulling in different ways upon a string fastened to the eye muscles of a rabbit every kind of defective refraction may be produced

New Light Upon Our Eyes

An Investigation Which May Result in Normal Vision for All, Without Glasses

By Mary Dudderidge

THE revelations regarding the physical condition of the American people which have resulted from the examination of men for military service under the Draft Law have come as a shock to the nation, but are no more than was expected by those who had previously been giving attention to such matters. Even under a liberal interpretation of the lowered standard which we adopted in 1909, when we abandoned the attempt to raise an army and navy with normal vision, defective eyesight has been one of the leading causes of rejection for service in both the Army and Navy, if it has not actually headed the list. In 1915 it was by far the most common of the defects found among applicants for enlistment in the Navy and Marine Corps. The total number refused for this cause among 106,392 was 12,374, while flat feet came next with only 8,188 cases. This too was under a standard which, while higher than that of the Army and Navy, is only three-quarters normal.

The fact is that defective sight is a world-wide plague, making its appearance along with civilization, and increasing just in proportion as modern modes of living are adopted. Statistics for the last fifty or one hundred years show that nine out of every ten persons over 21 usually have imperfect sight. At 31 the proportion is larger. Above 40 it is almost impossible to find a man or woman with perfect sight. For 100 years the medical profession has wrestled in vain with the problem, finding no means compatible with the conditions of modern life for preventing errors of refraction, and no means of relieving them except eyeglasses. These, at their best, are poor substitutes for natural sight and often fail to relieve discomfort or to stay the progress of the malady, which is a much more serious one than most people imagine. The oculist knows that present conditions are ominous of evil for the future, that the near-sighted, far-sighted, or astigmatic eye is disposed to all sorts of ocular diseases.

At the present time the general attitude of the medical profession toward this evil, which we have learned to take lightly only because it is so common, is one of hopelessness. Writers of books on the subject, practising ophthalmists and others, while admitting the inadequacy of the eyeglass, all assure us that it is the only remedy for errors of refraction; while the only means of prevention they can suggest is that of sparing the eye as much as possible from the close application necessitated not only by the modern educational system, where most of the trouble begins, but by many of the employments upon which human life now depends. Some have even concluded that nature, who could not have been expected to provide for such a tremendous change as has taken place in the environment of the human animal, was not in a position to make the eye properly, while several scientists of repute have held that a moderate degree of myopia is a kind of a natural adaptation, and should not be looked upon as abnormal. And while it is a commonplace that the hernia and the varicose veins so commonly found can be remedied by comparatively simple operations, that tuberculosis in its earlier stages will yield to rest and food and fresh air, and even that incipient cancer can be cut out, defects of vision are accepted as incurable, and no means of alleviating them are suggested except the one, fraught with peril to the soldier, of placing convex or concave glasses before the eyes.

It is therefore not a little surprising to find one eye specialist who has actually been curing errors of refraction without glasses for 30 years, and who as the result of a remarkable series of experiments has been able to present evidence which appears to invalidate most of the theories on which the present practice of opthalmology is based. Dr. William H. Bates of New York is already well known as the discoverer of the properties of adrenalin, an extract from the suprarenal gland of the sheep which is now used all over the world as an astringent and haemostatic; but his remarkable experiments on the eyes of animals and the startling conclusions that has drawn from them have, as yet, attracted comparatively little attention. Reported only in a few isolated articles, they have not yet found their way into the general literature of the subject and have scarcely been heard of by the lay public. Yet they promise to revolutionize the practice of opthalmology and are at the present moment of tremendous import to the country.

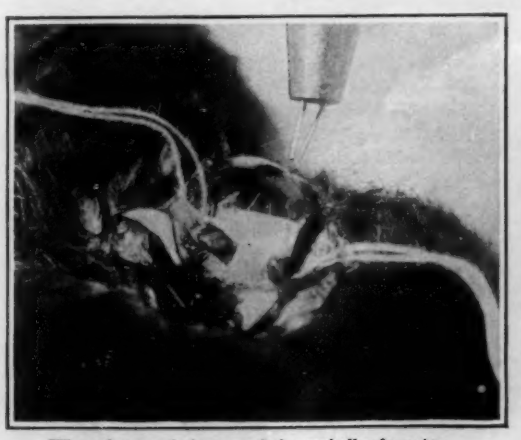
We were all taught at school that the accommodation of the eye depends upon an alteration in the curvature of the crystalline lens. Now defects of vision have been found to be associated with deviations from the normal in the shape of the eyeball, which ought to be a perfect sphere; and such deformations are always supposed to be permanent. In near-sight the sphere is elongated, so that it can be focussed accurately only on near objects. Rays of light coming from a distance are focussed in front of the retina instead of upon it. In far-sight the eyeball is too short, and the light rays are focussed behind the retina. In astigmatism the eyeball becomes lopsided, the deviation from the normal curvature not having been uniform. In an effort to overcome these conditions the crystalline lens is supposed to alter its curvature, through the agency of what is known as the ciliary muscle; on which theory the unfortunate muscle would have imposed upon it not only the ordinary labors of accommodation, but the duty of compensating for refractive errors; and from these labors it would practically never be free so long as the eye was open. The thought is really an appalling one, and is enough to drive the victim to eyeglasses, even if the physical discomfort of the situation did not do so.

Under the influence of this theory Dr. Bates at first diagnosed such cases of myopia and other refractive errors as he succeeded in curing as being merely functional, without any permanent change of shape in the eyeball. His success in treating the more severe forms of refractive error, however, led him to doubt the existence of an incurable class, and five years ago he undertook the series of experiments above alluded to for the purpose of testing the accepted theories. By the manipulation of the exterior muscles of the eyeball, the function of which has long been a matter of dispute, he was able to make the eyes of fishes, rabbits and other animals near-sighted, far-sighted or astigmatic at will. He therefore concluded that it was by the abnormal action of these muscles, rather than through the agency of the crystalline lens, that similar conditions were produced in the human eye, a view which was confirmed by observations on the human eye itself. He also observed accommodation taking place in eyes from which the crystalline lens had been removed.

In a series of experiments not yet concluded, Dr. Bates is attacking the problem from a new angle. Since light reflected from a curved surface must change its focus if there is any change in the curvature of that surface, he is photographing the filament of an electric light reflected from various surfaces of the eyeball. As no photographer could be found to do this work, he had to learn photography himself for the purpose, and it was two years before he was able to get any satisfactory pictures. The testimony of these photographs is that the whole eyeball

(Concluded on page 61)

With the muscle intact the eyeball responds to electric stimulus



When the muscle is severed the eyeball refuses to accommodate

With the muscle sewed together accommodation again takes place

Proving by experiment upon a rabbit eye that it is by means of the oblique muscles that accommodation for near vision is made

Strategic Moves of the War, January 3rd, 1918

By Our Military Expert

FOR some time now the principal scenes of the great war have been on the front of the armies facing each other in northern Italy. Each side has been putting forth tremendous efforts to place its full strength in the fighting lines. While the bulk of the Austro-Teuton forces have been gradually shifted from the lower Piave lines to the sector extending from Vidor through Quero and Cismon to the Asiago Plateau, these forces have also been strengthened from the Russian front, so that the numbers of troops in this part of the line have been nearly tripled—and are all the stronger since at least seven German divisions are known to be opposed to the Entente Allies here. This greatly increased strength accounts for the apparent gain as at Monte Asalone which was taken from the Italians only to be retaken by the latter after a series of desperate assaults seldom equalled even in this bloody war. In fact, these bitter combats have lasted with hardly an hour's cessation for many days; the first week saw the Italians steadily pushed back with the surrender of their mountain strongholds of Monte Beretta, Solarolo, Caprillo, Pertica and finally Asalone where only four miles separated the invaders from the Venetian plains as easy access could be had down the San Lorenzo valley. But the eighth day saw the Italians on the counter offensive and wresting some of the lost ground, especially Asalone, from the enemy. The latter mountain would have permitted the bulwark of Monte Grappa—the main Italian defense here—to be taken in flank; but by its recapture the Italians were again strongly and strategically located on this part of their front.

A new and vigorous onslaught by the Austro-Germans that had been expected for some time began on Christmas Eve west of the Brenta where, if they could drive down the Frenzella valley into that of the Brenta from the west, they would be well on their way out of the mountains and on the edge of the plains. This attack was followed by another on the east side of the Brenta where an attempt was made to come down the San Lorenzo valley from the east. These two attacks placed the Italians in a more serious position than at any time since they took their stand behind the Piave-Brenta-Asiago lines, for the enemy's plan was evidently one of a great encircling movement. If a passage down the Brenta valley to the plains could be forced, it is evident that, by sweeping around to the east, all the Entente Allied troops in the mountains between the Brenta and the Piave could be cut off. Even if no troops were cut off, a hurried retreat to the Adige with the consequent loss of territory and of the important cities of Bassano, Treviso, Venice and Padua, would be forced. Such a retreat would in addition be one of great peril for the army—far greater than it would have been as a continuance of the withdrawal from the Isonzo and the Tagliamento.

In the mountains where the fighting is now taking place, it had been hoped that the usual heavy snows would put an end to the Austro-German advance; but one of the mildest winters ever known for these regions has prevailed up to a few days ago. The valleys and even the mountain slopes ordinarily covered at this season with many feet of snow, were practically clear, permitting free movements of troops and supplies. This mild weather extended even to the eastern part of Venetia permitting unhindered lines of communications there also. But severe cold and storms have come in the mountains, and prisoners report that the desperate efforts of the enemy now are due to the desire to obtain access to the plains and control of the valleys leading to them before communications to the north are blocked with snow and ice. An ordinary mountain winter could not well be endured by troops camped en masse in the valleys and on the plateau around the heights. From Rome, the latest reports mention the recent heaviest snowfalls in 30 years. If this is the case, the Italian have a most powerful ally and the Austrians must give up hope of fully breaking through the Italian lines so far as to force at present another great retreat; their great object has been apparently to capture at least all the peaks of the great jumble of mountains between the Brenta and Piave so as to secure possession of the northern limit of the plains, where control of the country for miles could be obtained later when climatic conditions would not be so severe.

At present the task set appears to be a tremendous one—especially as the reorganized and rejuvenated Italian army has shown such surprising strength, spirit, and vigor as have been the case in the recapture of Asalone and on both sides of the Brenta River. The concentrations of Austro-German troops on the Asiago plateau and on the lower Piave River, though not so important are admittedly for the same general purpose of pressing the Italians at those points to prevent the withdrawal of troops to the Brenta-Piave section. As the case stands, now the Austro-Germans must make themselves masters of all the dominating mountains to the points where the Piave and Brenta break through to the plains. Their progress must necessarily be slow for the Italians will resist in every way, hoping not only for success in the fighting but for the aid of winter weather that will block all mountain passes and put an effectual stop to all hostile movements. Alpine storms are not to be despised for snow and cold would cut off all movement of supplies and the campaign would have to be closed. Bassano, one of the objectives of the Austro-German advance, is still ten miles away down the Brenta, even if the Austrians should be able to get as far as Valstagna and that is not at all probable at present.

As a whole, it is thought that winter has now defeated or will defeat the hopes of the Austro-Germans for a definite decision of the war on the plains of Venetia. On this portion of the front, the advance is already slowed up—if not definitely checked—although the enemy is nearly within sight of the plains and can reach Bassano with his heavy guns. It is almost certain that they cannot push forward beyond their present mountain positions and the opposing Italian defences except with great losses and by herculean efforts. Even to advance down the Brenta valley out of the mountains should not be easy since the Italians would hold the high ground on each side. The great question just now is whether the enemy can so improve his position as to outflank Monte Grappa; if he can advance south beyond this mountain to Bassano and hold it, the mountain positions will be turned—and with Grappa outflanked, the Piave line and Venice would both go. It is most important to hold the Frenzella and San Lorenzo

The German drive through the mountains upon Italy

valleys and to have available at the same time a strong force to attack if the Austro-Germans are finally able to debouch towards Bassano. Italy therefore needs all the troops she can muster and all the reinforcements that can be given her; it is a serious question whether her needs in men and guns can now be successfully met. The most encouraging news from this front is that of the recent French thrust forward near Monte Tomba where the most important success that has been gained by the Allies since the Italians fell back to the Piave line was scored. The positions taken by the French troops were between Monte Tomba and the junction point of the mountain lines with the upper Piave. If the Austro-Germans could be forced back here in this angle, a realinement of the entire front between the Asiago Plateau and the Piave River would be necessary and would make them give up much of their recent gains of ground. Whether this move is the first in a large scheme of offensive on the part of the Allies can not now be foretold; it is evidently realized that, if Venice and the Venetian plains are to be saved, a strong aggressive campaign must be undertaken. The French advance may be the beginning; it is at least encouraging to note that the defensive has been given up and that the French have pushed forward with enthusiasm and a sureness that give promise of success in future operations of this kind.

On the western lines there have been intermittent struggles all along the fronts almost from the North Sea to the Swiss border; but the long advertised German drive at some point or points here has not yet developed. Although some authorities predict several drives at the same time in the direction of Calais, Arras, Rheims, Verdun and even Nancy, it is considered highly improbable that any such moves will be attempted as a winter offensive. It has been calculated that Germany would withdraw from the Russian front for service in the west 50 divisions, leaving 20 to 30 on guard; this would mean from five hundred to seven hundred thousand men counting a division at ten to fourteen thousand. Austria is counted upon as being able to furnish ten or twenty divisions but this is entirely problematical.

Many believe there is a great tendency to exaggerate the capacity of the German railways to make transfers from the east to the west, as these roads are not in the pre-war conditions by any means but are greatly run down as regards road beds and rolling stock. At any rate, reliable information would indicate little or no serious changes in the distribution of German troops so far on the British, French or Italian fronts. The number of German divisions that participated in the advance in Italy from the Isonzo was six; it is believed that there are now only eight on this front amounting to ninety or one hundred thousand men.

On the west front in November there were 64 divisions opposite the British and 84 opposite the French; but this difference is not material as divisions are transferred from one part of the front to another where they may be needed. If Germany is to try in the near future a stroke with any hope that it may prove to be decisive, there is no definite indication as yet where it will fall; in view of the lack of success on the British sector, many believe such a blow might come in the Champagne or even somewhere in Alsace-Lorraine, though snow in the mountains and valleys would render military operations most difficult in this section. While the Germans might have the advantage here of getting troops from Russia, the French have a strong commander, strong positions, and an unfaltering determination to hold out. The British are stronger than ever, even though heavy reinforcements have been sent to Italy to oppose the Austrians; demonstrations may be made before their lines but it is hardly probable that any serious offensive against their portion of the front will take place.

The Germans for some time have thrust forward at many points with the obvious intent of testing out weak spots in the British and French defenses—in other words, they have been "nibbling" for a place at which to aim a possibly heavy blow. Since most of these strokes have been between Rheims and Verdun, it would appear as though it was intended to strike in this vicinity. There seems, however, little or no doubt on the part of both the English and French of their ability to parry with success any stroke that may come. Possibly Verdun might again be the scene of a struggle of giants; for the German railroads are nowhere in better condition than in this vicinity; the moral effect of a success here—no matter how small—would also be far greater than at any other point on the front There are some positions on the east bank of the Meuse where dominating ridges are still held by the Germans and attacks might be attended with some success, at least in the beginning.

It has been pointed out by experts that, if Germany is to start a grand offensive, she would be better prepared now as regards numbers than even before the Crown Prince began his great attack at Verdun.

The collapse of Russia has enabled or will enable the transfers of so many troops from that front that their influence in any offensive would be at once felt. If the great attack is to be made, it is believed the delay is not so much due to moving troops as to the difficulty of transporting to the British-French fronts the enormous amounts of military stores required; it is thought too that a great part of the heavy guns and material have been withdrawn from the east and are now either on the western front or en route to it. If the new operations are to begin, it is expected that they might begin at an early date if weather conditions will allow.

In Palestine, the British commander appears to have begun his advance to the north by striking at both ends of his line near Jerusalem and also on the coast. Four miles north of Jaffa, the seaport of Jerusalem, the Auga River enters the Mediterranean; this river has been crossed on rafts and light bridges and several ridges in the north side captured. These include high grounds to the north which have also been occupied.

To Our Subscribers

IN the present congested condition of our railroads not only are freight and express goods delayed, but even the mails are greatly disturbed. Consequently the SCIENTIFIC AMERICAN is likely to reach you behind schedule time. Do not be alarmed if your copy is several days overdue. If you have renewed your subscription it will reach you safely in due course.

Cotton as a Food Plant

Congressional Action Needed To Give It the Place Which It Can Fill

By Lehman Johnson

ON almost every public building in the United States we find the slogan "Food Will Win the War; Don't Waste it." This is all very well for winter time; but with the coming of spring we will everywhere need to write it "Food Will Win the War; Grow it."

Food means proteins, fats and carbohydrates. The largest single undeveloped source for these in the United States lies in the cotton plant. The fact that this is a food plant, dimly recognized by economists, has not been accepted as yet by the United States Department of Argiculture; and, sleeping on its rights, this Department has left it to the new Food Administration to take a few halting steps in the right direction. Had the Department of Agriculture fully realized and accepted the cotton plant as a food plant, and acted upon that realization when the European War began three and a half years ago, it could have done four things to make a place for the cotton plant as the decisive factor in the war—four things which remain, for the most part, as yet undone.

First, the Department could have insisted that the Federal Government prevent the cotton and cotton-seed crops of 1914-15 from being marketed at half the cost of production, or even at so low a price as to discourage production. Second, it could have insisted that, for the duration of the war at least, the cotton states go on raising cotton in large quantity as a food plant, under some government provision that any surplus fibre, long or short, which would inordinately reduce the price, be taken care of, and stored against the tremendous demand which we all know will come with peace. Third, it could have insisted that the growers themselves recognize and grow cotton as a food plant, that they care for the seed as the more familiar cereals are cared for, and that they utilize, upon the farms where the plants are grown, those of its food constituents suitable for such use, alike in the production of meat and of work. And fourth, it could have insisted that cotton seed meal be not considered as a mere manufactured product falling under the special and almost exclusive charge of the millers, but rather as a true agricultural product, the commercial cereal representative of the cotton seed; and it could have gone far toward determining the exact value of that meal and its exact limitations as food for man, for cattle, for sheep, for hogs, for mules, and for poultry. The fact that not one of these things was done is another illustration of the fundamental unpreparedness of our nation for war. But it is not even now too late to do some of these things for the express purpose of winning the war.

The Department of Agriculture has done, is constantly doing, splendid work in many lines. But with reference to the cotton plant, more's the pity, it has indulged rather in destructive than in constructive criticism. It has deposed King Cotton and left the industry in confusion. If anyone doubts this, or that there is need of a tremendous amount of constructive work to fit the cotton plant for its part in winning the war, let him look at these facts:

The cotton crop has declined from 16,000,000 bales to 11,000,000, and the cotton-seed crop from 533,000,000 bushels to 367,000,000; while during four years the price of the staple has varied between 4 and 30 cents per pound, and that of the seed between ½ and 4 cents per pound. There are six times as many gins and three times as many oil mills in the cotton states as are needed to gin the cotton and mill the seed—increasing the cost to the consumer of the product.

The boll-weevil, the hook-worm and the cattle-tick, the three great foes of efficiency in cotton plant production, still occupy their every line of defense.

In comparison with what there could and should be, one may say that there are no sheep, dairy cows, cattle, hogs or mules raised in the cotton states. Thousands upon thousands of tons of cotton-seed meal, rich in protein, fats and carbohydrates, are buried directly in the ground as fertilizer, instead of being so used indirectly through live-stock after being turned into manure.

Although in other sections there are excellent barns where hay at $20 and corn at $50 per ton are stored and distributed month by month to live stock, there are no barns in the cotton states in which seed cotton at $75 or cottonseed at $250 per ton can be stored, ripened, and supplied month by month to the ginners and millers; nor is there any provision of law or custom by which, having stored either of these properly upon his own land, the farmer may borrow money on them as manufacturers and miners can upon their products.

The cotton crop is raised with mules fed almost entirely upon corn, much of which has to be imported from other states. Yet when combined with a portion of ear cornmeal, the mixture affords a better and a cheaper feed and furnishes a richer manure; and every animal husbandman connected with the southern experiment stations has approved this feed and urged the government to sanction it and promulgate it as a war-time food-saving proposition.

There are four confusing grades of concentrated cotton-seed meal made and marketed when there should be but one—and of the four none possesses all the food elements of the seed in natural or balanced proportions. The laws and regulations relating to this food product, both national and state, encourage and in many cases require that meal be made less and less like corn, less and less like a natural and safe feed, more and more suited only for exportation and direct use as a fertilizer.

All possible credit should be given the United States Food Administration for its courage in undertaking to clarify the situation as to the cotton-seed crop, and for the good it has undoubtedly done in this direction. Much more it will be able to do when it has corrected its more serious errors and when it shall have secured a complete and thorough investigation of all the easily obtained facts relating to the chemistry, botany and economics of the cotton plant and its products. After such an investigation of the cotton plant *as a food plant*, it would perhaps be best to intrust the Food Administration with complete control of the cotton plant, both as to food and fibre, for another year or for the duration of the war.

The one thing that can be done, the one thing that should be done immediately, is for Congress to authorize the President to appoint such a board of investigators, and on the basis of their findings to frame and present for passage, before planting time, a bill which shall place the cotton plant and all of its products, food and otherwise, under government control until the conclusion of the war. The cotton plant must be democratized, it must be accepted as a food plant, willingly and patriotically, completely and honestly, and so treated by all, if it is to make its fullest contribution toward the success of our cause.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Academic Freedom

To the Editor of the SCIENTIFIC AMERICAN:

May I, who am an ordinary factory worker, but a proud American, anxious that my country may promote with its tremendous power the highest and best things in the life of the world, without being presumptuous, point out the mischievous fallacy in the argument of President Butler, which you quote with approval in a recent editorial? I believe it has escaped your attention and reflection, else you would not have added the great weight of your evident sincerity and your journal's great prestige to so harmful a doctrine.

Instead of President Butler's Bryanesque definition of "Academic Freedom" being illuminating, it is confusing and beside the point. It is a sort of statement which, on first reading, seems to express the case exactly, but which appears positively inane on a little reflection. Can a man really say what he thinks without thinking what he says? If this could be truthfully said of anyone, it is of those who voice the inherited and conventional thought, rather than of those few who actually do some individual personal creative thinking. From the very force of habit of social inertia and momentum, majorities are almost always wrong in the beginning. Freedom in the realms of thought, opinions and their expression may be safely given even to those who are in error, for then those who are in the right will be equally free to combat the error with their truth. Isn't it strange that the world has such a hard time to believe in the possibility of freedom even in its necessity for the attainment of the highest unity.

President Butler's argument will condemn the German who dares to oppose the theory of force upon which his Government acts and it will condemn President Wilson in his attempt to induce Germans to run counter to the traditions and purposes of the nation. It will justify every tyranny of official and group opinion toward its own non-conformist members which history later revealed were that group's benefactors and saviors.

We are reminded that the radical professor is negligent of his "academic obligation" in running counter to the traditions associated with his organization, whose administrative policies and purposes are accepted or formulated by those few who wield its financial support. But suppose these policies, purposes and traditions need to be altered to prevent the loss or even to weaken the prestige of the institution? Then who is really "loyal to the institution?" Again, is a university an institution to be served, or does it exist for service? Force which may be effective for good in the realm of material possessions can only do harm in the spiritual realm of education and science. The University exists and merits the support of society for the discovery and dissemination of truth. "Academic freedom" is the "*sine qua non*" for the discovery of truth. That that freedom gives expression to what the university, meaning its business managers, disapproves of, or to what the supporting society disapproves of, is no reason for limiting that freedom. Is saving and transforming truth a matter which depends upon the "power and prestige" of an institution for its dissemination and general acceptance? Isn't the worst enemy of truth he who uses force either in its suppression or in its extension? Surely from the standpoint of the welfare of society the "prestige" of a university which rests on any other foundation than its earned reputation for absolute loyalty to the truth, ought to be destroyed. The erudition and conformity of the German professors can never overbalance the terrible curse they have brought upon the world by their subserviency to the forces which demanded "loyalty" to the accepted traditions and practices of Prussian Militarism. What President Butler demands and you approve seems to me the most abominable prostitution our materialistic age has produced.

Whenever the University employs the weapon of "the stamp of heresy" to weaken its Doctors' loyalty to the truth, it ought to lose its "prestige"—and if I rightly sense the spirit of American life, it surely will. Truth crushed to earth proverbially doesn't stay there, but the fruits of the attempt to crush it are sad and evil. Truth gets associated with so much that is deleterious, the university falls so far beneath its rightful and possible service, that all lovers of men must weep. Another lamentable thing is that the policy of forcible suppression—"conform or get out"—not only fails permanently to crush the truth, it fails to crush error. Error, meeting with the same treatment as truth, lays claim to identity of quality, and so corrupts the people. Isn't it worth while to believe that the sunlight of truth will dissipate the clouds of error? Isn't it true, historically demonstrable? Isn't it the supremely American thing to foster the development of the creative self-expressive instincts which require and increase liberty, rather than the instincts of possession and the lust of power which so readily turn to the use of arbitrary force? Not in the maintenance of the status quo, but in the discovery of and the obedience to the truth is their salvation.

I haven't said I agree with the professors who have been fired. That is another matter entirely.

W. G. GREESON.

Moline, Ill.

(*See page 50 for Editorial Comment.*—ED.)

Another Opinion

To the Editor of the SCIENTIFIC AMERICAN:

Many thanks for your editorial, "Academic Freedom." With slight changes in the wording it would apply *in toto* to teachers of heresy in theological seminaries which bear the name of orthodox churches. "It is a clear case of conform or get out."

JAS. W. MARSHALL.

Junction City, Ark.

Bombing Planes

To the Editor of the SCIENTIFIC AMERICAN:

I notice in your issue of December 15th, 1917, Mr. Allen M. Culver gives a very interesting article on a substitute for the big gun.

Mr. Culver's idea is, I'm afraid, one that he has not given much thought. He speaks of manufacturing a very inexpensive type of airplane suitable for carrying a large, high-explosive bomb about thirty or forty miles and being timed to drop on the objective at that distance.

What would hinder the enemy from destroying the machine with anti-aircraft guns? Or if at too great a height they could send up a few machines equipped with machine guns and leisurely pick them off in their flight.

ROY S. TOYLE.

Irvington, N. J.

A lock and movable dam of bridge type across the lower Mohawk, one of eight similar structures between Schenectady and Little Falls. The gates are raised and lowered by electric winches

Two new locks at Lockport replace one t
over the Niagara escarpment natu

New York State Barge Canal

Completing a Great Waterway from the Lakes to the Atlantic

By D. B. La Du, Special Deputy State Engineer

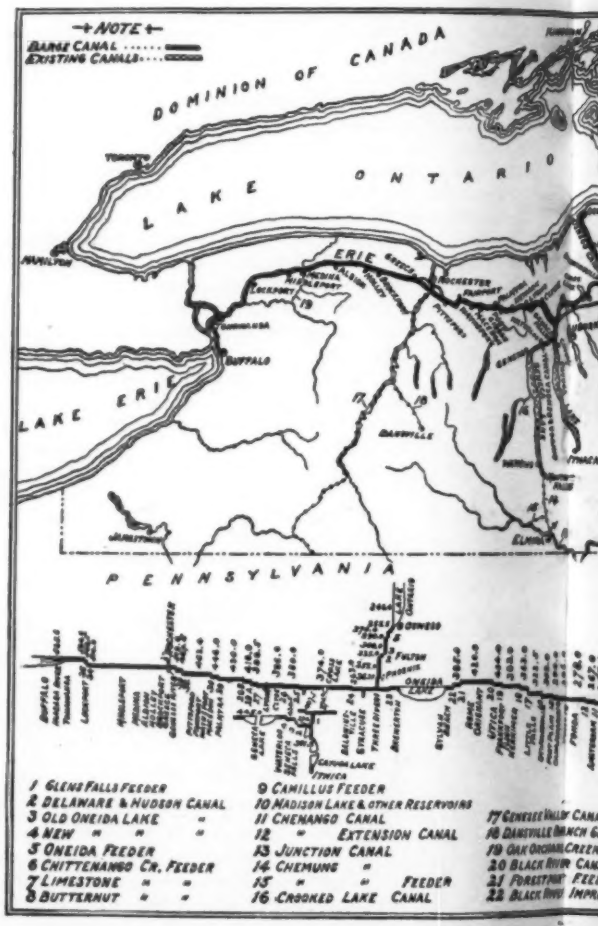
Reinforced concrete lighthouse, 85 feet high, at Sylvan Beach

THE New York State Barge Canal is being completed most opportunely. Never before in the history of our nation has there been greater need for just the work which it is especially fitted to do. If plans had been laid with a knowledge of the future, its advent could not have been more timely. A supreme emergency is upon us and the canal is ready to carry its share of the overwhelming load which necessity has imposed. In America we have come to depend very largely upon our railways, because of the general insufficiency of our waterways, but in this the hour of our direst need our railways cannot bear the full burden which must be borne, if we are to be successful in the most stupendous task we have ever set ourselves—the waging of our present war.

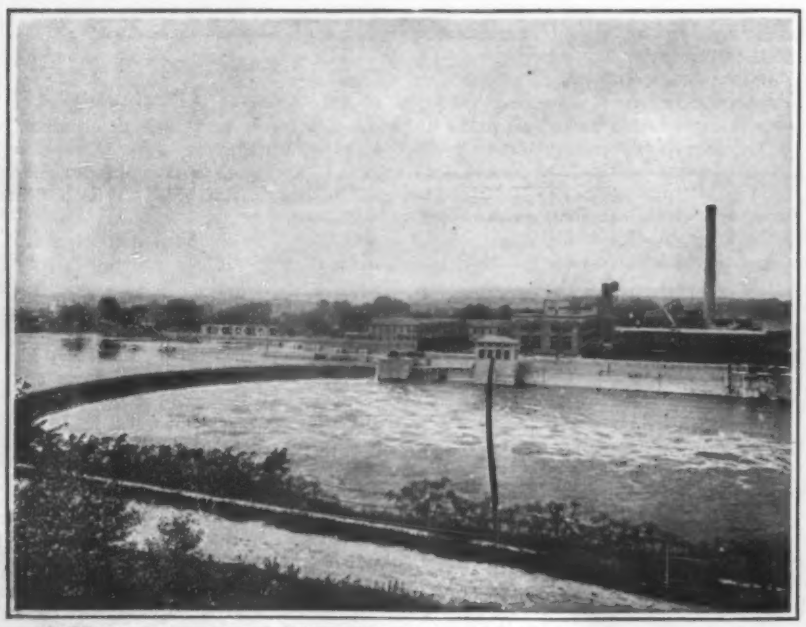
Also, the Barge Canal is being completed most auspiciously—at a time when the pendulum of almost universal public favor is swinging to its side. There have been two opinions on the waterways question and the opponents of canals have been as unremitting in their activity as the advocates. But now that the crucial test has come, opposition to waterways is in large measure disappearing. The country is threatened with an almost fatal freight blockade, in spite of unprecedented efforts to bring our railroads to their maximum of efficiency, and in our extremity friends and opponents alike are welcoming the help of the waterways, which alone can materially relieve the pressure. The Barge Canal which is being completed so opportunely and so auspiciously has been given considerable publicity during the dozen years of its building and those who have cared to know have learned that it is the improvement of four branches of the State system and that these branches stretch almost or entirely across New York State at three places—at one place extending across the center from east to west, at another (counting the Hudson River a part of the system) reaching from the northern to the southern limits where the north and south dimension is greatest, and at another stretching nearly across the state from north to south midway on the east and west branch. Interested people have read, too, something concerning the size and cost of the canal, and know about its numerous and noteworthy structures, and have been told that by many it is considered a greater engineering feat than the Panama Canal.

But probably there are few who fully realize how strategic is the position which the Barge Canal occupies—that it is the essential link between two great chains of internal navigation, which reach to all of the Atlantic coast states and to much of the Middle West.

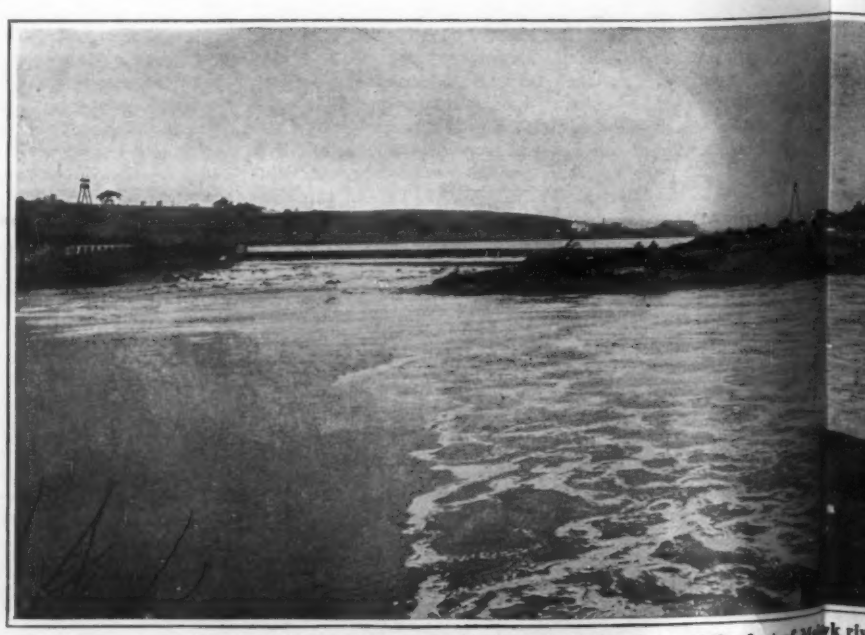
At the western extremity of the Barge Canal our great inland seas form a mighty system of natural navigation. It was to connect the territory surrounding these lakes with the Atlantic Ocean that New York built its first canal a hundred years ago. Not content with reaching the area immediately adjoining the lakes, plans have been projected to extend navigation still farther by means of canals. There are four of these projects which are worthy of notice. These are, first, the Lake Erie and Ohio River Canal, which would join the Ohio River at Pittsburgh with Lake Erie, and for which complete surveys and estimates have been made



Map and profiles of Ne Yor

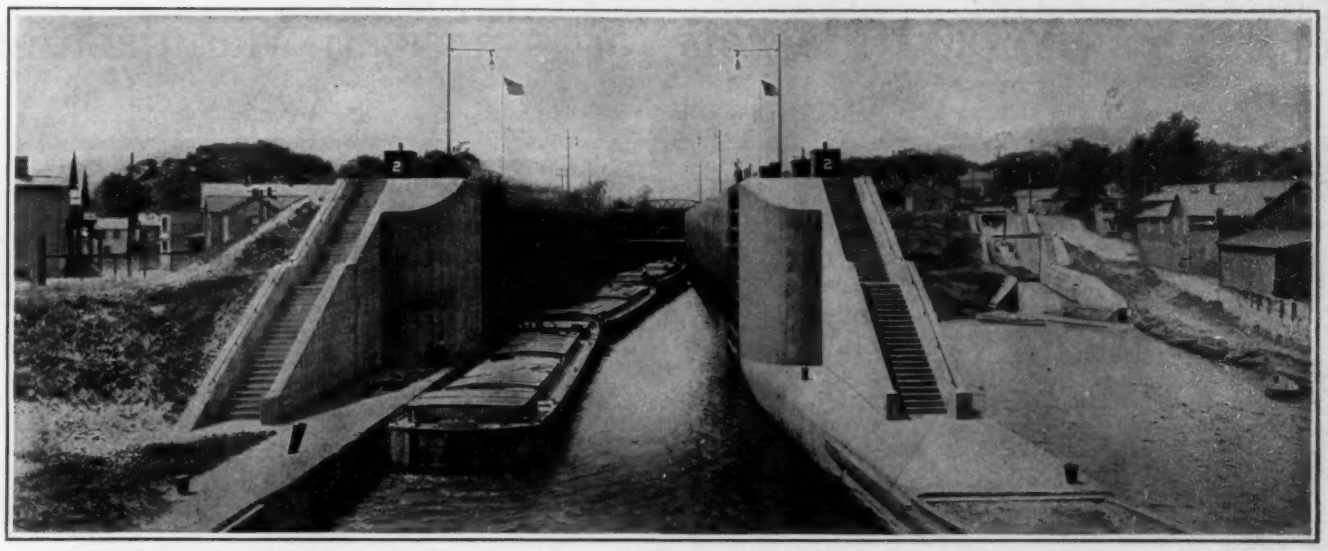


At Minetto, where a curved dam of gravity type has been built on the east side, a lock in the center, and power-plant head-gates on the west side



Crescent dam, a circular gravity dam, 1,922 feet long, at the foot of M k riv
eight movable dams of bridge type canalize the Mo k a q

replace one tier of five old locks. This drop
arpment nature prepared for the canal



First lock ascending from the Hudson river, where the new Erie canal starts westward in its course across the state. A flight of three old locks at the right (used now as a by-pass) shows well comparative sizes

es of New York State barge canal

by the States of Ohio and Pennsylvania; second, the Lake Erie and Lake Michigan Canal, surveyed by the United States engineers and joining the heads of Lakes Erie and Michigan by a line only one-third the length of the present natural route, thus bringing Chicago, Milwaukee and Grand Rapids that much nearer to the ocean; third, the proposed improvement of existing canals in Illinois, which extend between Lake Michigan and the Mississippi River; fourth, a canal from the head of Lake Superior to the cities of Minneapolis and St. Paul.

It is scarcely necessary to call attention to the importance of these proposed canals—what it means, for example, to place Pittsburgh with its steel industries and the great twin cities with their grain and flour interests on a vast Lakes-to-Atlantic waterway system—nor to point out the vital position the Barge Canal occupies in this mighty chain of improvements.

At the eastern end of the New York canal another immense waterway system has been planned. This is the project backed by the Atlantic Deeper Waterways Association. The plan contemplates an intracoastal canal which gives an inside passage along most of our Atlantic coast. This canal comes under Federal authority and parts of it are already being constructed. With the completion of the various parts there will be available a continuous navigation of 1,800 miles.

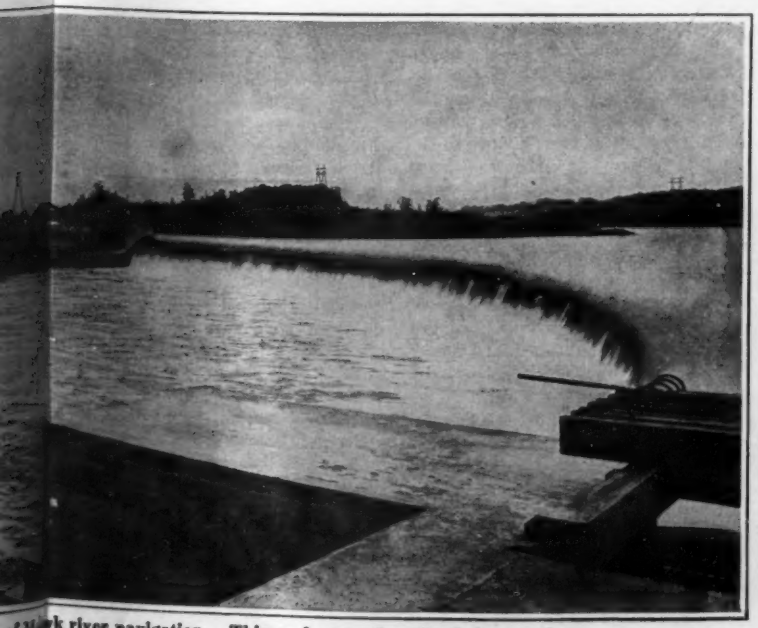
The mileage of waterways in the Great Lakes and intracoastal projects, together with their connecting link, thus becomes very large. Even now there are 1,500 miles of navigation in the Lakes and 800 miles in the New York waterways. If the 1,800 miles of the intracoastal chain and the improvements adjacent to the Great Lakes are eventually added, the total length of the system and the area influenced will indeed be vast. And the supreme importance of the connecting link in this system is vividly apparent.

There is something else which is not generally appreciated, and that is the importance of the territory through which the Barge Canal itself runs, as a region in which certain products originate and others are consumed. The original canals were responsible for the founding of a chain of cities and villages across the Empire State, the like of which does not exist elsewhere in the whole country. Directly upon New York's waterways of Barge Canal dimensions there are situated more than thirty cities, some ninety villages and many hamlets, while other populous communities are but a few miles away. A study of the State's population reveals the fact that nearly 75 per cent of the people live within two miles of the waterways. As New York's population is one-tenth that of the whole country, we see that about seven per cent of the people of the United States are within a half hour's walk of the New York waterway system. From this we can see what it means to the State and to the country at large that the products of these seven or eight million people and the supplies they need have available a cheap means of transportation.

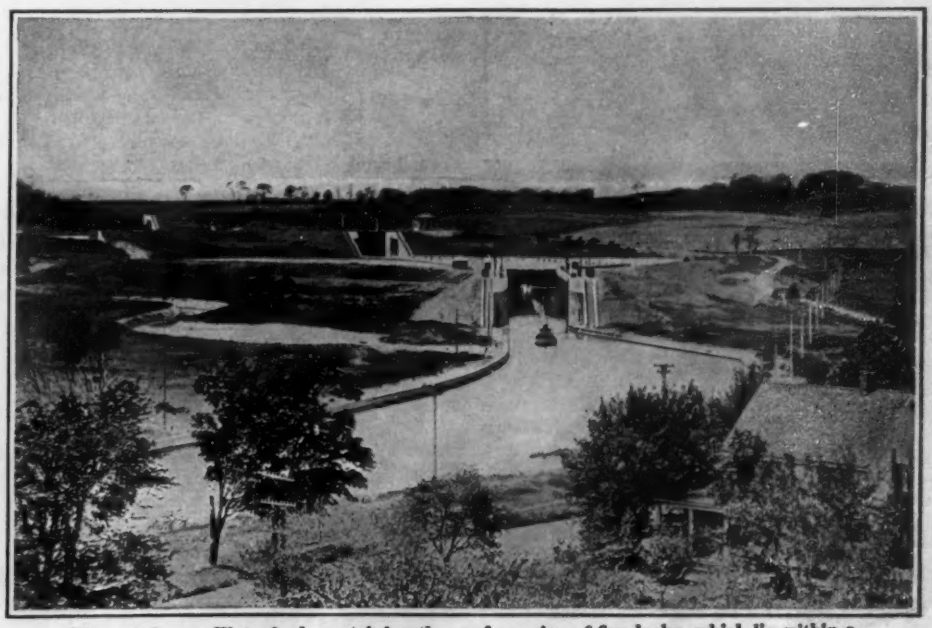
Moreover, the natural and manufactured products originating in close proximity to the Barge Canal are of no mean proportions. A study made by the Barge Canal Terminal Commission some six or seven years ago showed that by a very conservative estimate the region along the improved canal alone, not including anything on the Hudson River south of Albany, produced annually more than ten million tons of freight suitable for transportation by canal.

One of the last things to be accomplished in Barge Canal construction is the building of lighthouses and other aids to navigation. A boatman could not go astray in the old canal. There was nothing to do but to keep within the narrow channel bordered by a bank on either side. But the channel of the new canal throughout much of its length lies somewhere in the broad expense of river bed or lake area, a condition which has made necessary the use of numerous devices to mark the courses, such as buoys, stake lights, beacons, markings on bridges, range towers and lighthouses. Certain specific colors of painting indicate by day the position of the marker with reference to the channel and the colored lights which show by night tell the same relationship. The Federal practice in

(Concluded on page 63)



of Mohawk river navigation. This and one other fixed dam and
the Mohawk a quarter of the way across the state



The canal near Waterford, containing three of a series of five locks, which lie within a stretch of 1½ miles and form the greatest flight of high-lift locks in the world

World Markets for American Manufactures

Conducted by WILLIAM W. SNIFFIN

A department devoted to the extension of American trade in foreign lands

Japan's Manufacturing Industries

In common with the recent tendency of many countries to develop a home production of numerous articles formerly imported from abroad, the growth of manufacturing industries in Japan since the outbreak of the European war has been remarkable. The principal industries to experience this increase in output are iron and steel, zinc, aluminum and lead, mining, metal products and machinery, shipbuilding, electrical goods, textiles, chemicals, oils and paints, etc.

Production of iron is increasing substantially and, though still small, gives promise of great importance in the future.

The needs, however, are by no means supplied by domestic production and large imports from abroad, especially from the United States, are reported. Indeed the value of iron and steel bars, plates and sheets imported from the United States for the eight months from January to August, 1917, amounted to $36,876,000, constituting 36 per cent of the imports from the United States and supplanting the imports of cotton, which amounted to only 30 per cent. In this period, the amount of iron and steel sent to Japan from the United States weighed 300,000 long tons, four times as much as the cotton.

With this increase in iron and steel production and importation, shipbuilding also has been carried on actively since the outbreak of the war. By the latest reports (September, 1917) there were 113 shipbuilding slips, owned by 42 different firms, and with a capacity of one ship of 1,000 tons to each slip. Shipbuilding is being pushed to the greatest capacity of the plants and, subject to supplies of iron and steel materials, Japan will be able to build more than 250 ships, aggregating a million tons, annually.

Many new companies have been organized recently for the production of zinc, aluminum and lead, and metals of a grade superior to any before produced are reported. Copper and coal are also being mined, though the latter, with a production of 1,743,803 tons for the month of last September, is regarded as having fallen below expectations. Facilities for the mining of silver and sulphur and the production of petroleum are also being increased. Six new companies with a combined capital of 16,450,000 yen[1], have been organized for the production and refining of mineral oils.

Companies for the manufacture of galvanized iron sheets, galvanized iron wire and wire netting have been established in recent years and are now preparing to export their products abroad. Machinery, especially rotary printing machines and machines for the manufacture of war munitions, gun metal, etc., are now being manufactured in Japan. Three new companies, with a capital totaling 2,300,000 yen, have been established for the purpose of manufacturing machinery. Six companies, with a total capital of 4,530,000 yen and operating 11 factories, have been organized since the outbreak of the war with the object of manufacturing electrical supplies and accessories, such as motors, dynamos, switches, lamp bulbs, carbon electrodes, carbon brushes, etc.

The textile industry has developed extensively since 1914 and at least 11 new companies, with a combined capital of 16,600,000 yen and operating 14 factories, have been established. While some are general mills for the manufacture of cotton and woolen goods, others specialize; one in linen thread, one in mixed silk and woollen goods, one in finishing silk textiles for export and one in hemp rope. One company also is devoted to the spinning of ramie fiber, which, though a product of Japan and China, has hitherto been imported.

A greater advance, however, has taken place in the chemical industry than in any others, and at least 20 new companies, with a combined capital of about 30,000,000 yen and 28 factories, have been organized. Their chief products are sulphate of ammonia, potassium chloride, caustic soda, bleaching powder, niter, sulphate of potash, potassium carbonate, sodium sulphide, sodium chloride, sodium peroxide, iodine, fatty and stearic acids, nitric acid, glycerin, oils, dyes, drugs, fertilizers, disinfectants, phosphorus, etc. Some eighty firms are producing potassium chloride, while formalin is also being produced in large quantities, but for home requirements alone. With the assistance of the Government, one company is producing indirect dyes for domestic use, while direct dyes are being manufactured for export. Several new companies have been formed for the manufacture of various paints.

Many other new manufactures have been developed in Japan since the outbreak of the war. There are, for example, concerns for the manufacture of bicycles and rubber bicycle accessories, with the intention later of manufacturing and repairing motor cars; for the manufacture of boots and shoes, with preparations for manufacturing of slippers, harness, knapsacks and other leather goods; and for the manufacture of imitation celluloid, to be used largely as a substitute for lacquer, artificial leather and rubber. Various other products now being manufactured are plate glass, bricks, corks, explosives and dynamite.

[1]Yen = $.498 U. S. currency normal exchange.

The export trade of Japan is a reflex of the country's prosperity and figures published recently by the Japanese Department of Agriculture and Commerce for the first nine months of 1917 show that exports amounted to 1,141,041,000 yen, an increase of nearly fifty per cent over the same period in 1916. The chief exports were raw silk and waste silk, habutai, cotton cloth and cotton yarns, copper, zinc, coal, matches, refined sugar, rice, timber and crockery.

Preponderance of United States' Trade with Guatemala

The United States maintains very close commercial relations with the republic of Guatemala, recently the scene of a devastating earthquake that destroyed its capital, Guatemala City. With an import trade of $6,725,601 and an export trade of $10,618,176 during 1916, the country sent to the United States $8,668,573 worth of goods and imported $5,228,325 worth. The leading article of production and export is coffee, but since the outbreak of the war, Guatemala has been entirely cut off from its principal markets—England and Germany. An effort to create a demand for Guatemalan coffee in the United States has just begun to be successful. If this country continues to purchase the larger portion of Guatemala's coffee, it will stimulate the sale of American goods in that republic.

During the year 1916 the United States exported to Guatemala the entire supply of the following commodities carried into that country: Coal, flour, glass, porcelain and earthenware, leather goods, lumber, machinery, crude and refined petroleum, railway materials, and manufactures of wood and iron, copper, tin and lead. With the United Kingdom, the United States divided the imports of cotton goods, flax, hemp and jute manufactures, foodstuffs not otherwise specified, iron manufactures and woollen goods into Guatemala, while in addition to the United States and the United Kingdom, France, Spain, and Japan also sent in certain goods.

The United States supplied 57 per cent of Guatemala's cotton goods in 1916 and this in the face of much more liberal terms from England and Germany. It will be possible by a propaganda of education and by better banking facilities to improve this trade considerably. In the manufactures of iron, copper, tin and lead, and their compounds the United States, during 1916, supplied over 93 per cent of the entire trade. The gain in the imports of electrical goods from this country more than offset the loss of the trade from Germany, but severe competition with that country is likely to follow the declaration of peace. Ninety-five per cent of Guatemala's industrial and agricultural machinery came from the United States in 1916. The machinery most in demand is repair machinery and small power plants for sawing lumber and cleaning coffee. In leather goods the position of the United States amounts almost to a monopoly, but the local production of shoes, saddlery, etc., is growing. There is also a market for sugar-mill machinery, agricultural implements, standard and light railway materials, girders, bridges, concrete mixers, building materials, sawmill and logging machinery, small electric lighting and power plants, cotton and woollen goods, chemicals and all kinds of foodstuffs.

The United States' share of the 1916 export trade of Guatemala amounted to 81.6 per cent, which was made up largely of coffee, bananas, sugar, hides and deerskins. As a result of the recent disaster it is not unlikely that a heavy demand for building materials will be created and perhaps new machinery and stocks to replace materials destroyed in the earthquake. American manufacturers should, to the best of their ability, come to the aid of the little sister republic, especially in view of the fact that other sources of supply are largely cut off.

Organization for Foreign Trade in Germany

The United States Bureau of Foreign and Domestic Commerce has recently published a study of German foreign-trade organization, compiled by Chauncey D. Snow, the assistant chief of the Bureau. The author makes clear his purpose "in no way to disparage the methods of American firms" and states that his remarks are not "intended as a eulogy of things German," but "to indicate the points in German training and the German conduct of affairs that are generally recognized as contributing to German success in foreign trade."

The history of the German export trade is summarized briefly and is followed by a discussion of the attitude assumed in Germany toward preparing for a commercial career, with reference to the schools of commerce, the study of foreign languages and industrial education. One of the chief means adopted by Germany for promoting trade was German settlements in foreign countries, which remained under the control of a central agency. German residents and importing houses in foreign countries were also expected to aid in the development of German foreign trade. Important coöperation in this movement has, moreover, been rendered by German banks and the expansion of a great merchant marine. The assistance rendered by the Government —by publications, commercial and agricultural experts and consular officers, and by commercial treaties and customs tariffs—has, of course been far-reaching in its accomplishment and systematic in its methods.

Private and semi-public trade associations have, moreover, exerted a powerful influence and had a most important result on the volume of trade. Combinations to limit output and fix minimum prices, forbidden in the United States, are permitted in Germany. General foreign trade methods and credit terms are discussed in the closing pages of the bulletin.

This publication is entitled "German Foreign-Trade Organization" (Miscellaneous Series No. 57). The document is interesting as offering the facts of the German foreign trade methods for comparison with American practices. The author concludes his monograph with the admonition to American business men that in Germany individual business men, local and national associations of business men and the Government departments are even now strenuously occupied with the problems of foreign trade for the future.

American Boots and Shoes in Certain Foreign Markets

Porto Rico, while not a new market for the boots and shoes of the United States, is an interesting and attractive field for exporters, who usually regard it as a foreign market. As a possession of the United States, of course, no import duty is levied on goods brought from this country. Shoes, as a general practice, are bought in job lots and, since the average buying capacity of the Porto Rican is small, are attractive mainly through the price, rather than the style and quality. Medium and high-grade shoes are, however, finding a growing market. The United States supplies about ninety per cent of the import trade in boots and shoes, though in the fiscal year ending June 30th, 1916, its share rose to 99 per cent, consisting of 1,367,799 pairs, valued at $1,353,778. The island for the last few years has taken the surplus product of American shoe factories and the proceeds of bankruptcy sales of shoe stocks of all descriptions.

The island of Jamaica receives more than half its imports from the United States, even in normal times. Its proximity to this country makes the United States the logical market, despite the fact that the island is a British possession. In 1915, of the total imports of the island—$11,326,578—54 per cent were from the United States and of the total exports—$10,845,797—47 per cent were taken by this country. The share of the United States in the footwear trade with Jamaica arose from 64 per cent in 1912 to 76 per cent in 1915, valued at $288,378. The only serious competitor is the United Kingdom. Much of the recent gain of the United States in this market is due to war conditions. In high-grade and medium lines, the United States has little difficulty in retaining the major portion of the island's trade, but the cheap goods and certain medium-grade shoes, formerly largely controlled by British manufacturers, offer opportunities that should not be overlooked.

Another possession of Great Britain—New Zealand—imports about half its total consumption of footwear, amounting to 1,750,000 pairs. This trade includes not only rubber-soled tennis and outing shoes and rubber boots, but principally the higher grades of ordinary dress shoes. The market, though small, should be attractive to American exporters, because of the dependable character of the shoe dealers and the fact that the people think favorably of American manufactures and can afford to buy the higher priced footwear. Owing largely to war conditions and the difficulty of getting shoes from England, which has always been the principal importer into New Zealand, the share of the United States in this trade rose from 5.7 per cent in 1915 to 9 per cent in 1916, amounting in the latter year to $174,839.

Saving Waste Lumber at Army Cantonments

ANYONE who has ever built a frame house remembers the pile of scrap lumber—pieces of board, shingles, and the like—that remained after the house was completed. What then must be the pile of waste lumber that accumulates in the construction of hundreds of wooden buildings at a single one of the sixteen cantonments being completed for the National Army?

At Camp Funston, near Fort Riley, Kansas, which incidentally is the second largest cantonment in the country, much of the lumber which would ordinarily have been wasted was put back into use. The rapidity with which the building operations had to be carried on, with approximately a thousand buildings under construction, tended to make workmen discard pieces of lumber which under less pressing circumstances would have been cut into shape on the spot. The men often could not or did not take the time to work over material when speed was essential. So automobile trucks were kept busy throughout the day gathering up these scraps of lumber and hauling them to the outskirts of the cantonment. The writer found no one would hazard a guess as to the money value of the two huge piles of lumber thus discarded.

One of the huge piles of waste lumber accumulating during the construction of an army city

Open air shop where the waste lumber is cut up into standard small sizes and thus saved

Buzz saws, operated by gasoline engines, were maintained and a force of workmen was kept busy sorting out the good and bad lumber from these piles. The rough and split edges were trimmed off, the wood cut into other lengths, and sent back to be used over. Even comparatively small pieces were cut down into usable blocks, a pile of which is shown in one of our illustrations. There was of course a large amount of lumber which could be sent back to the workmen without any alteration whatever. Much of this found its way to the scrap pile by mistake. One of the foremen told the writer of a load of perfectly good siding which had been brought out that day. It had been ordered out of the way by another foreman. All that was necessary was to turn the truck around and send it back.

The prompt collection of all scrap lumber did much to minimize the fire risk where there were small piles of boards scattered about. Whatever of the supply of this waste lumber could not be worked over into suitable building material was kept for kindling, to be used by the National Army upon taking possession of the cantonment after completion.

Concrete Snowsheds of Novel Design

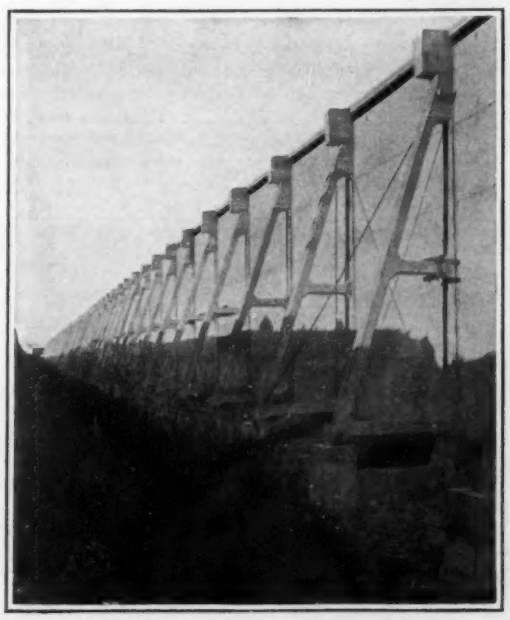
A SNOWSHED of novel contruction has just been adopted by the Union Pacific railroad for its Wyoming lines. It will be recalled that last winter one of the worst snow blockades in the road's history took place in that state, when several thousand men had to be rushed to Rock River to dig away the cement-like mixture of snow, dirt and gravel which the rotary plows found almost impregnable. In order to obviate a possible repetition of any such occurrence, the engineering department at Omaha designed a snowshed of concrete with entirely new and original features.

The most striking feature about the sheds under construction is not so much the fact that they are of reinforced concrete, but that they are so constructed in units that at a later time they may be readily dismantled and moved to another location on the road, if protection from snow should prove more necessary elsewhere. Complex features have been eliminated in this piece of concrete construction and the building of the sheds has been resolved into only four main units. "A" frames, concrete braces in the shape of a letter "A," placed at intervals of 15 feet on each side, support the walls. The walls themselves are composed of thin slabs of reinforced concrete, 15 feet long, 4 feet wide, and 2½ inches thick, which fit into the "A" frames. Concrete girders, extending across the tops of the "A" frames on either side, form the support for the roof, and slabs, similar to the wall slabs, are used for roofing. The wall slabs sometimes have been designated as "concrete lumber."

The sheds are supported wherever possible on concrete piles, sunk ten to thirty feet into the ground. Where the rocky ground did not admit of piling being used, "footings," extending only about four feet into the ground, were substituted. At any time the sheds may be dismantled by simply removing the "A" frames, slabs and roof girders. Then they can be loaded on cars, and moved elsewhere.

These sheds are in decided contrast to the ordinary wooden sheds, being of an artistic design and decidedly light and airy. Rows of the slabs have purposely been omitted on the roof, as well as one row on the leeward side, giving locomotive smoke an opportunity to escape, and letting the sunlight in. Perhaps the most important consideration in the adoption of concrete construction has been the elimination of the fire risk, quite pronounced in the case of locomotives passing through wooden sheds.

Four separate concrete sheds are under construction. The longest is 4,470 feet in length and is located near the Rock River station. The other three, varying in length from 495 feet to 1,800 feet, have been placed at intervals in the 27-mile stretch west from Rock River to Como. All of the sheds span a double track, and at one point near Rock River, three tracks. The total cost of the project is about $750,000.



The "A" frames supporting the walls

One of the new snowsheds of reinforced concrete

The Current Supplement

AS the war progresses scientific studies of various phases of human interest have developed. One of the latest is *The Biological Aspects of the War*, which deals with the instincts and restraints that affect human relations, and will be found in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2193, for January 12th. *The Nature of Sun-Spots* gives much information in relation to a subject that has occupied the attention of scientists for many years and includes studies of their life history. It is accompanied by explanatory illustrations. *Whale Beef and Whales* tells of a new article of food that has been recommended by our Government experts. *The Fur Trade of the United States* gives considerable information in regard to a branch of commerce in which our country has taken the leading place in the world, and is illustrated by a number of excellent photographs. *National Fuel Research in England* tells something of what the British are doing in a systematic effort for domestic economy, both for the present and with regard to the future. This matter is one that will of necessity be given close attention in this country in the near future, in which connection the above report will be of value. *Some Factors in Illuminating Engineering* deals with the production of visual sensations, and contains much that is of practical value. It is illustrated by several diagrams. The interesting story, *The Experiences of an Iron Atom*, is concluded.

Fatal Results of Feeding Nuts to Live Stock

THE shortage of fodder in Holland is affecting the health of live stock because of substitutions—in some cases fatally.

Recently reports have been frequent of the death of stall-fed animals, attributed to spoiled or otherwise unwholesome feed. In many such cases the animals have been freely given acorns, chestnuts and beechnuts, unshelled and uncooked. All of these nuts, it is averred, in their natural state have poisonous elements, especially in the shells. It is said that horses have died within twenty-four hours after eating raw and unshelled beechnuts in considerable quantities, the stomach and intestines being fatally disordered.

Experts advise that nuts be fed to stock in limited quantities, not more than a kilo (2.2 pounds) at the utmost per day, and then only after they have been shelled and boiled, care being taken to throw away the boiling water. It is remarked, however, that nuts can be fed more freely to pigs than to other animals, and that, besides, they are very fattening.

Fiber Containers as a Substitute for Glass and Tin

THE use of fiber containers in marketing various food products has greatly increased because of the shortage of tin plate. The principal question raised concerns the kinds of products that can be successfully marked in such containers. The Bureau of Foreign and Domestic Commerce has been advised by a manufacturer that the following-named articles have been successfully handled by the users of its fiber containers: Sirups that do not ferment; jellies, jams, marmalades; honey; salted nuts; marshmallow products known under trade names such as marshmallow whip, mallow topping, and the like (these products to be used for soda-fountain trade, household use, etc.); marshmallows; hard candies; chocolate-coated confections; sugar butter (spread for bread); malted milk; glacé fruit; shoe whitening; cocoa; and almost every one of the most commonly used spices.

The following products may be packed in fiber containers for a short length of time: Cottage cheese and other soft curd cheeses, lard, pickled fish, sausage meat, horseradish, sauerkraut, ice cream, and various delicatessen products and soda-fountain supplies.

Another use for the fiber containers is as measures for dried products, such as crackers, small cakes, salted peanuts, salted and dry-cured fish of many varieties and most kinds of sweets and candies.

One concern has reported that it has an order for fiber containers to be used for holding a liquid chemical fire extinguisher.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

The Whys and Why-Nots of Deep-Water Diving

ONE of the problems with which inventors have long been struggling is that presented by diving in deep water. In general terms, water pressure may be reckoned as 4½ pounds per square inch for each 10 feet in depth; and after passing a depth of 100 feet, it very rapidly becomes impossible for a man in an ordinary diving suit to put forth any considerable effort. Previous to the F-4 exploit, the greatest depth at which effective work had been recorded was 182 feet; and this was a truly extraordinary performance.

The many inventors who have tried to design a diving costume for use at abnormal depths have realized that the joker lies in the necessity for furnishing the diver with means of motion. It is a simple enough matter to encase a man in a suit of steel armor sufficiently stout to resist the pressure at any given depth; ability to grasp a tool is readily enough secured by the adoption of some kind of special clutch at the end of a rigid gauntlet; but it seems that the tool can be used only when there is provided, at elbows and shoulders and again at knees and hips, some sort of a flexible section interrupting the continuity of the rigid steel suit.

Here is where the Senegambian is located in the woodpile. The joint may be made either of a single piece of some tough but flexible material of the general nature of leather, or it may be built up from several pieces of rigid metal playing upon one another after the model of the flexible gas tubing. But in the first instance there is the greatest difficulty in insuring against a weak spot that will burst and let the water in, while the task of making a connection which shall be watertight under pressure between metal and, say, leather, is far from child's play; and in the second case it is equally difficult to make the joint tight at the places where successive segments bear upon one another. So more than a few would-be crackers of this nut have seen their carefully constructed suits blow in under pressure.

Granting that this obstacle has been met, however, and inventors there have been who have met it successfully, there is another and rather humorous aspect of the situation which almost invariably escapes advance notice. Such a joint as we mention, whichever way it may be built, must in the very nature of things present a varying volume in its varying positions. It can only be moved from a position in which it occupies a less volume to one in which it occupies a greater one by displacement of water; and displacement of water against the resistance of 100 pounds or more per square inch presented at depths exceeding 200 feet is not a thing of which the unaided muscular strength of a human arm or leg is capable. Accordingly when a diver gets past this depth, he finds his motions circumscribed by the fact that he can move his joints only in the direction which decreases their displacement. He may be able to flex his arm, but cannot then straighten it again; or vice versa. Moreover, there is certainly one position in which each joint presents a minimum volume; and having once got in that position it is locked, as it were, and the unhappy diver cannot use it at all, but can only stand, a motionless prisoner, until hauled up into a less pressing environment.

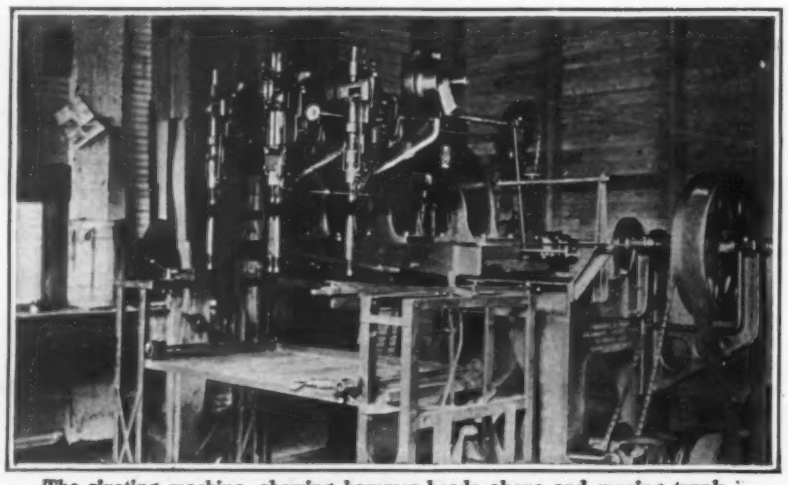
A typical deep-water diving costume

A Mechanical Riveter for the Trunk Factory

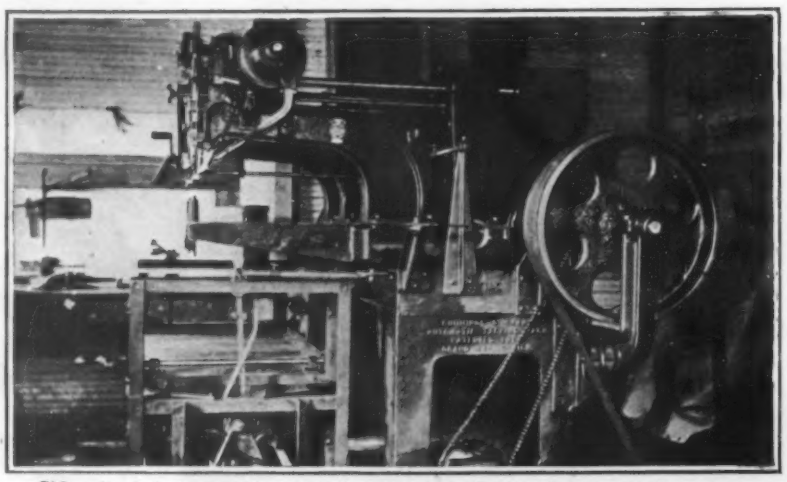
AT the present time all the rivets and tacks which are so prominent a feature of every trunk are driven by a machine operated by one man with hand and foot power. His greatest speed is from eight to ten rivets per minute. There is no guarantee of a neat apppearance to the finished article and the work is very slow.

A machine which is just on the market does away with all this unnecessary work. It will drive 432 rivets per minute, doing therefore the work of forty men. Each additional driver will add to the speed of the machine at the rate of 108 rivets per minute. And a single operator will, it is thought, with experience on this machine, develop ability to drive rivets or tacks at the enormous rate of more than 850 every minute.

The machine shown here is about 5 by 5 feet and the height of an ordinary man. More drivers can be added if necessary. It finishes a whole side of a trunk without being touched by human hands. It is operated by a 3 horse-power motor. The trunk is clamped to the automatic trunk feeder and thus rivets are driven in straight lines and a neat appearance assured. The machine can be gaged to set rivets or tacks on top of each other or an inch and a half apart.



The riveting machine, showing hammer-heads above and moving trunk-carriage below



Side view of the machine, showing how the riveters hang over the space occupied by the trunk

The Literature of Torpedoes

A LIST of references to material in the New York Public Library on the subject of torpedoes, compiled by W. A. Elis, is published in the October *Bulletin* of the Library. The references number 1,500, covering the years 1630 to 1917, and many of them are annotated. There is an alphabetical author index.

Notes for Inventors

Feeding the Typewriter.—At the recent Business Show held in New York City, there was abundant evidence that the inventors have in late years devoted considerable attention to office appliances. Among other things there were several ingenious machines for feeding envelopes or letter-heads to the conventional typewriter, increasing the typists' output anywhere from 25 to 50 per cent. Such feeders are made in various sizes and styles for feeding envelopes, letter-heads, invoices, telegraph blanks, plain paper, and so on.

A Copy Holder for Stenographers.—There has recently been introduced a copy holder for stenographers, the main feature of which is a member known as the line-finder, which moves down one line every time an operating lever is depressed. The stenographer or typist, placing her note book or other copy in the holder, proceeds to typewrite, and each time a line of copy is read she lightly taps the operating lever of the copy-holder, causing the line-finder to drop down one line. Obviously, this device saves much time and avoids those mistakes which are so troublesome in following copy.

Measuring Distances by Means of Prismatic Binoculars.—There are already in existence numerous ingenious instruments for measuring distances. Frequently, however, it is desirable to estimate a certain distance with a fair amount of accuracy, and by the simplest means possible. This is not always an easy matter, especially in unfamiliar surroundings, and only after long practice will such estimates turn out comparatively accurate. An instrument which is of great assistance in judging distances is the prismatic form of binoculars when provided with a calibrated disk. These disks, states *Motor* of Berlin, enhance the already many-sided utility of the prismatic binoculars, and offer the further advantage that they do not in the slightest interfere with the view when the binoculars are used for the purpose for which they were originally designed. The calibrated disk, which consists of a thin glass plate with the divisional lines marked on it, is placed in the right-hand barrel. By means of the disk the distance to an object of known dimensions can be ascertained, or, conversely, if the distance be known the dimensions of the object can be found. Disks are now manufactured which are calibrated according to the purpose for which they are intended.

Hour Glass Principle for Operating Cameras.—A remarkably ingenious device is that of Jesse H. Dolby of Elgin, Ill., for the automatic operation of a camera. His self-operating camera shutter incorporates the hour glass principle, in which sand passes from an upper container to a lower one through an orifice of variable size. When the emptying of the upper container has reached a certain point, the device rotates and unmasks the lens for an instant. The time between the setting of the shutter and its operation may be regulated by adjusting the orifice between the containers. The device is fastened to the lens of any camera.

Three Phonographs in One.—Henry Barnes Tremaine and Edwin Scott Votey of Westfield, N. J. and Summit, N. J., respectively, have secured patent rights on a phonograph arrangement making use of a plurality of tone arms. While the exact purpose of this arrangement is not disclosed, it is obvious that the plan is to provide three different types of reproducers for use either on different types of records, or for different selections of the same type of record. It has been said before in these columns that where sound is concerned, the natural period of the various elements entering into the recording and the reproducing of the sound is an all-important consideration. Thus it hardly seems good practice to make one reproducer serve for selections of all kinds, ranging from the thundering brass band to the soft, high-pitched voice of the soprano soloist; yet that is precisely what is being done with all phonographs of the present. No doubt the phonograph of the future will be provided either with a plurality of tone arms and reproducers, or with a reproducer whose natural period may be readily altered to suit the record.

New Light Upon Our Eyes

(Concluded from page 53)

changes its shape during accommodation, and that the crystalline lens does not. The image has changed on the sclera, or white of the eye, and on the cornea, growing larger or smaller according as the convexity of the reflecting surface was altered; but no change was observed when it was reflected from the lens. These results are as yet wholly tentative; the investigation upon which they are based is still in progress, with the hope of attaining greater accuracy.

These accumulated observations have left no doubt in Dr. Bates' mind that the deformations of the eyeball upon which errors of refraction depend are due to an abnormal strain upon the extrinsic muscles of the orb of vision, and that, far from being permanent, they last only so long as the strain continues. This abnormal action always results from a strain to see, conscious or unconscious. When the eyes strain to see distant things the oblique muscles contract and by elongating the eyeball produce the myopic refraction. When they strain to see near things the recti muscles contract and by flattening the eyeball produce the hypermetropic refraction. The problem of curing errors of refraction, therefore, is to induce the eyes to take it easy, and look at things without effort.

This is accomplished by a system of eye education so simple that patients, when they are cured, proceed at once to cure their relatives and friends. Teachers have also used it successfully to prevent and cure myopia in their pupils. More than one thousand children with defective sight have regained normal vision by this means. In one class in which there had been 27 eye defectives, 25 were reported cured, while one truant and one incorrigible had become good students, because they were now able to study without pain.

The fundamental principle of this new system of eye training is what Dr. Bates calls central fixation. The trouble with the civilized eye, he says, is that we use it as though it were a photographic camera. The camera can see everything which falls upon its sensitive plate equally well, but the human eye is not built that way. The retina has more nerve cells in the center than any where else, and therefore is designed to see one point better than others in its field of vision. In other words, we see best in the direction in which we are looking. When we submit to this, the eye, is at rest, and, Dr. Bates asks us to believe, contrary to all previous testimony and experience on the subject, it can never tire, no matter how much it is used for near work or any other kind of work. It can work all day and all night, he says, and while the rest of the body will tire it will not. But when the eye attempts to see every point in its field of vision about as well as the central point, not only is its visual power lowered, but it is subjected to a severe strain, as anyone can observe for himself by trying to see every part of any surface of four or five inches in extent, or even much less, equally well at one time. This strain Dr. Bates believes to be at the bottom of most eye troubles.

Central fixation is attained by two methods, practice and rest, the latter coming first. To rest the eyes the patient is told to look at something black and then cover his eyes in such a way as to exclude the light and avoid pressure on the eyeballs. If he remembers the black perfectly, he will see black. Otherwise he may see all the colors of the rainbow, but usually sees gray. When one does succeed in seeing black the effect is very surprising. The vision is noticeably improved, though it may be only for a moment, and letters on the test card that one was unable to see before stand out clearly. The explanation offered for this phenomenon is that the eyes and brain are relaxed by seeing black, thus enabling the former to function normally. Incidentally if one has had any headache or pain in the eyes it will probably be gone. Whether the black is seen or remembered, the effect is similar, and as one cannot have the color always before the eyes, nor see with them closed, the person who wants to see normally must learn to remember black just as well with the eyes open as shut.

The familiar Snellen eye chart, used by all oculists to test the eyes of their patients, is used as a basis for the practice of central fixation, the patient being directed to try to see one part of a letter better than another. The relief which this simple expedient gives to tired eyes is astonishing, and the smaller the letter selected for the purpose the greater it is.

By means of this simple system of eye education Dr. Bates maintains that the organs of vision can be kept always in a normal condition. The savage presumably got this education from his daily life. He was obliged, as a condition of continued existence, to focus his eyes for accurate vision at all distances. If he didn't he was eliminated. We who are protected from all the dangers from which our savage forebears could protect themselves only by their good eyesight, and whose eyes are limited for a great part of the time to a narrow range of vision, quite naturally lose this power. Under a similar conditions wild animals lose it also, becoming myopic in captivity, although they neither read nor write nor sew nor set type. The remedy is not to close our schools and stop our printing presses and return to a primitive condition in which there was no astimatism or short sight, but to practice the art of seeing perfectly for a few minutes every day.

The Phonograph in the Remote Districts of India

THE universality of the phonograph is much in evidence in India, especially in the centers of population. Talking machines are very largely used in Madras among those who have means to buy, beyond the bare necessaries, certain comforts or luxuries which cost only a moderate amount. In the wealthier homes of the zamindars, rajahs and others numbers of such instruments are found, but not to the same extent. Of the total population of Madras, 518,660, it is estimated that something more than 30,000 or about 6 per cent might be considered as possible users or purchasers of talking machines.

A large proportion of the poorer people are not unfamiliar with talking machines, even though they do not possess any, as it is a common practice for companies or individuals to tour the country, giving concerts with the machines, and taking up collections from the villagers or country people who gather to hear them. In this way the machines have penetrated into the most remote districts and have thus an established popularity.

It is said that the greater number of records sold in India, except among the European community, are in Indian languages—Tamil, Telugu, Marathi, Kanarese Hindustani, etc., Of these the first two are the most generally in use in the Madras district, Hindustani not being commonly employed in southern India. For Europeans, however, of whom there are about 4,000 in Madras and 14,000 in the Presidency, nearly all English people, records are in English. A fair number of talking machines is found in homes of the Europeans, but probably not in as great a proportion as among the moderately well-to-do East Indians.

At the present time the records are obtained in English from London, these being made either there or in America; while some in Hindistani are obtained from Bombay. It appears that Calcutta is the only place in India where records in native languages are actually being manufactured. Formerly many such records were made in Germany, as firms there sent representatives to India to record the songs or recitations of the leading Indian artists, and afterwards reproduced these on disks which were then offered for sale in India. Several Indian dramatic or musical artists have a reputation throughout parts or in all of India, and records reproducing their best-known pieces are popular. Instrumental music comical songs, etc., also make popular records.

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RECENTLY PATENTED INVENTIONS

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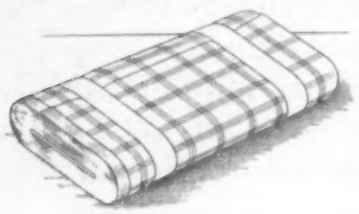
Pertaining to Apparel

CLOTH FOLD PROTECTOR.—J. MCKENDRIC, 109 St. James Place, Brooklyn, N. Y. This invention relates to cloth handling devices, and has particular reference to means for protecting the fold of high grade fabrics, such as are commonly rolled into bolts in doubled or folded condition. Among the objects is to provide a means whereby the doubled portion or edge is protected from deterioration due to soiling from the hands, counters, shelves or the like, or from damage due to exposure to the sunlight.



CLOTH FOLD PROTECTOR

GARTER ATTACHMENT FOR SUPPORTING STOCKINGS.—S. N. and R. CHANEY, Magnolia, La. This invention is an elastic device for supporting stockings from garters, it being formed of spring material and constructed with hooks at its respective ends for engagement with and detachable connection of stockings and garters. The latter do not require to be made of rubber or other elastic material in order to hold their place on the leg of the user, for the reason that the elasticity required is supplied by the portion of the device to which the garter ends are attached.

SHOE FASTENER.—J. W. HANLEY, 204 E. 51st St, New York, N. Y. Among the objects of the invention is to provide a fastener for a shoe comprising an endless or closed loop at its upper portion adapted to take the place of the usual pair of loose ends which must be knotted or tied after the lacing is completed. Another object is to provide a fastener which economizes over on ordinary shoe-string fastener in the element of time for fastening and unfastening.

GARMENT.—A. G. TUBBS and L. W. SWEET, Box A, Chatham, N. Y. The invention relates to union suits, the upper part being interchangeably attached to the trousers. In order to accomplish the desired result use is made of trousers provided at the upper front portion with spaced lacing openings, an upper piece of wearing apparel such as a jacket or a bib, provided at its lower portion with lacing openings, and a lacing interlaced with the sets of lacing openings to detachably fasten the trousers and the upper piece together.

Electrical Devices

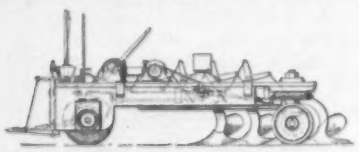
FUSE PULLER.—E. H. LOWE, Modesto, Calif. The invention relates to fuse pullers, and has for its object to provide mechanism in connection with the ordinary fuse plug for permitting it to be engaged by the usual threaded insulator pin, to permit the withdrawal or replacement of the plug without requiring the same to be touched by the hands of the operator.

VIBRATING MACHINE.—C. CARROLL, Box 502, Chicago, Ill. The invention has for its object the provision of mechanism of the character specified by means of which a rapid vibration may be imparted to the body of the person being treated particularly to the muscles of the arms, chest and neck.

Of Interest to Farmers

SCYTHE.—C. L. SMITH, Ponca, Nebraska. The object of this invention is to provide means for connecting the blade to the snathe in such manner that the blade may be rotated around the snathe and may be adjusted angularly with respect to the snathe and will be held firmly in adjustable position without the necessity of providing openings in the snathe, and wherein the blade is so arranged that it is stronger at the heel than at any other point.

POWER DRIVEN FARM IMPLEMENT.—P. POWERS, Cairo, Ill. The invention relates generally to power-driven machines for farmers' use, its object is to provide a portable motor-driven frame having means by which suitable soil treating and crop harvesting devices may be interchangeably attached, and of such nature that it is capable of ready and easy control by the operator.



A SIDE ELEVATION OF THE MACHINE

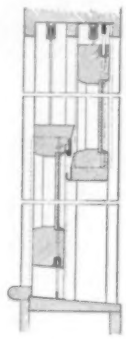
CHURN OPERATING MECHANISM.—C. S. WAYBRIGHT, Staunton, Va. The invention has for its object to provide a simple and inexpensive mechanism capable of use with any form of churn, and adapted for connection with fixed supports, as for instance, a wall or the like, and wherein a bracket is provided having open bearings for the dasher and a guide for a reciprocating bar, together with a cord adapted to encircle the dasher and connected at its ends to the bar to rotate the dasher when the bar is reciprocated.

ELASTIC CRIB.—L. H. DICKELMAN, Forest, Ohio. An object of the invention is to provide an all metal crib which is rat proof and vermin proof and which affords ample facilities for proper ventilation of the grain, a bin which is made up of sections so that the size may be varied by merely adding to or subtracting from the number of sections, the crib is of light weight and may be readily set up.

Of General Interest

COPY HOLDER ATTACHMENT FOR TYPEWRITERS.—W. E. GRAY, address Bartels, Blood and Bancroft, 728-35 Foster Bldg. Denver, Colo. The invention relates generally to copy holding attachments for typewriters and more particularly to means for supporting a copy holding plate. The object to be accomplished by these improvements is the rigid support of the copy holding plate in such a manner as to permit of its being readily and quickly adjusted when desired.

WEATHER STRIPS.—R. W. CROSS, 718 Fletcher St., Dallas, Texas. This invention relates to the type of weather strips comprising mating members, the one member presenting a groove and the other a tongue to enter the groove The prime object is to provide a weather strip which is rain proof, draft proof, durable, and easily applied and one that will not result in the sash or door sticking, but which will be self-adjusting under conditions due shrinking or swelling of wood structures, or following the settling of the house or like contingences.



TRANSVERSE VERTICAL SECTION SHOWING SASHES OF A WINDOW EQUIPPED WITH THE INVENTION

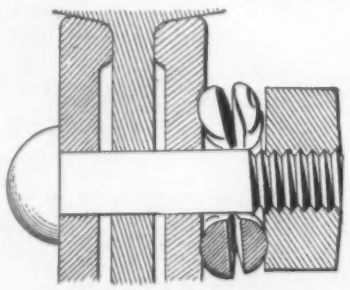
ROAD DRAG.—E. C. LEAK, McGill, Nevada. The principal objects of the invention is to provide a drag for eradicating the ridges and ruts in a roadway, whereby the latter may be maintained in good condition. Another object is to provide a drag in which simplicity and economy of manufacture are coupled with durability and efficiency in operation.

SHADE ROLLER.—J. W. PRICE, Henryetta, Okla. One of the principal objects of the invention is to simplify the construction and arrangement of the parts of shade rollers of the ratchet and pawl type, and more particularly of the type in which a gravity actuated pawl is employed, and to provide mechanism of such nature as to be readily applicable to shade rollers of standard construction.

DENTAL MIXING SLAB.—S. L. JEFFERIES, Spartanburg, S. C. The invention has for its object the provision of a slab especially designed for mixing plastic material, for use by dentists and the like, wherein the slab is so arranged that it may be used more than once without the necessity of cleaning, the slab being provided with two or more mixing faces.

Hardware and Tools

NUT LOCK.—T. HAND, Orland, Fla., The invention has for its object to provide a lock, wherein a split washer is provided having left-hand spiral ribs or threads and having its ends offset with respect to each other laterally and being split at its ends and intermediate, its ends in the plane of the washer, the sides of the split being separated for the purpose specified.



A SECTION SHOWING SPLIT WASHER

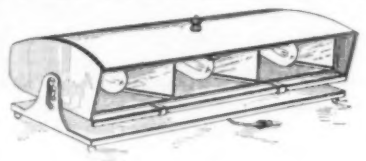
APPARATUS FOR MANUFACTURING PLATES.—J. M. A. FAURE Limoges, France. This device may be conveniently mounted on the frame of laths at present employed for molding by hand and thus enable manual labor to be superseded by mechanical operation without interfering with existing conditions. The machine comprises a mold, a molding tool, a gaging tool, a turret head carrying these tools for bringing them successively into contact with the clay a spring-operated rack, gears between the rack and the turret head, and a device for setting the rack.

SPRING HINGE.—O. KATZENBERGER, care of Lawson Manufacturing Co., 228 W. Superior St., Chicago, Ill. An object of this invention is to provide a construction for protecting the spring. Another object is to provide a spring having a barrel formed with notches and caps on the ends, for giving a better appearance to the entire structure, and at the same time protecting the spring against the elements.

Heating and Lighting

CANDELABRUM.—B. A. CLARKE, address Walter J. Clarke, 373 Lexington St., Auburndale, Mass. The invention relates particularly to a plate provided with extensions adapted to carry candles or lights. Other objects are to provide a candelabrum with detachable light carriers, which can be easily and quickly secured in position, and which is particularly adaptable for use in connection with birthday parties.

DRAFTSMAN'S LAMP.—R. L. RIZER, Cumberland, Md. One of the principal objects of the invention is to provide a lighting device designed particularly for the use of draftsmen, illustrators architects, and the like, which will operate to illuminate the drawing board or desk top in such manner as to almost completely dissipate the shadow formed by an instrument in the hands of the worker before the light, the device being so constructed as to confine the light to a horizontal beam, thereby keeping the light out of the draftsman's eyes.



PERSPECTIVE VIEW OF THE LAMP

Household Utilities

COFFEE MILL.—A. I. GONSALVES, Funchal, Maderia Island. This invention has particular reference to a manual device which is simple, compact, and by means of which a small amount of coffee may be quickly ground. Another object is to provide a mill for coffee which is closed entirely during the grinding so that the aroma is prevented from escaping as the coffee is ground.

COFFEE MAKING APPARATUS.—J. L. GUIMARÃES, Rio De Janeiro, Brazil. This apparatus comprises a boiler having a flat top and provided with upper and lower communicating water chambers, a burner chamber between them, and an upwardly extending pipe leading from the upper water chamber, a water receptacle secured to the boiler, having a tube leading from its bottom to the lower water chamber, and a removable coffee pot, having at its upper end an opening into which the end of the tube of the boiler extends. The heat supplied to the boiler will also heat the coffee pot and maintain the infusion therein hot.

BED SUPPORT.—J. E. BUTLER, Cowen, Calif. This invention has for its object to provide mechanism especially adapted for use in hospitals and sick rooms, for perventing the patient, when sitting up, from slipping towards the foot of the bed. The support comprises a pair of bars which are spaced apart, and are connected by a series of cross bars, a set screw engages the side rail to clamp the parts, the device may also be used in connection with a pillow either as a foot or knee rest.

Machines and Mechanical Devices

WASHING MACHINE.—H. A. BURLEY, R. F. D., No. 2, Milwaukee, Oregon. The main object of the invention is to provide means for agitating or pounding articles being washed automatically actuated by the generation of steam in the apparatus, another object is to provide a safety device which directs excess steam into the clothes receptacle another object is to provide a float valve in the pounder operating means to prevent the entrance of air into said means when raised to its upward limit.

COTTON-PICKING MACHINE.—W. L. FODREA, Little Rock, Ark. The object of the invention is to provide a machine consisting of a wheeled support which may be driven through the field and which is provided with exhausting apparatus, with flexible hose for receiving the cotton as it is picked, and wherein other mechanism is provided for positively removing the cotton from the boll and delivering it to the exhausting mechanism.

RECIPROCATING PUMP.—H. F. HOFFMAN, 1570 Richmond Turnpike, S. I., N. Y. The invention relates to reciprocating pumps adapted particularly to ammonia compressors or the like. Among the objects is to provide piston delivery valve mechanisms so designed that the fluid being pumped will be permitted to pass as freely as possible from one stage to the next, whereby friction and consequent heating of the parts will be reduced to a minimum.

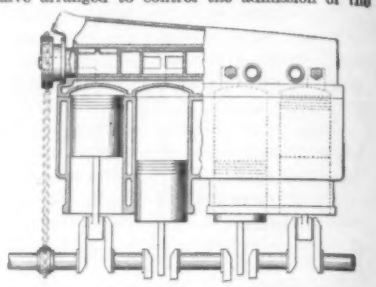
Musial Devices

ATTACHMENT FOR TALKING MACHINES.—L. MORONEY, Manhattan Beach, Ore. The invention relates to means adapted to be attached to a talking machine of the Edison type, whereby to cause the raising and lowering of the cover to perform various detail operations. The inventor provides means whereby the horn is automatically swung to bring the sound box over the record and then lowered, the operations being performed by the lowering of the cover, and the reverse operations take place by the raising of the cover.

Prime Movers and Their Accessories

LIQUID FUEL FOR INTERNAL-COMBUSTION ENGINES.—J. P. FOSTER, Paia, Territory of Hawaii. An object of this invention is to provide a gasoline substitute, which may be used under the same conditions that gasoline is used. The internal combustion engine need not be changed at all, the new fuel may be used at the same pressure, it may be used without deleterious effects, it does not require preheating in order to vaporize it, and it may be made of waste products which have hitherto not been utilized; its base is alcohol with the addition of sulfuric ether, a neutralizing agent, and one which at the same time denatures the alcohol.

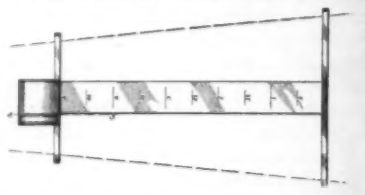
ROTARY VALVE.—C. W. COMSTOCK, Dilley, Ore. The invention relates to internal combustion engines, the object being to provide a rotary valve arranged to control the admission of the explosive mixture and the exhaust of the spent gases, in a practically noiseless manner, and to insure proper ignition of the charges the mechanism is exceedingly simple as it requires but a single bore in the valve casing and a single tubular valve rotating in the bore to supply the several cylinders with the motive agent and to conduct the spent gases from the cylinder.



SIDE ELEVATION OF ROTARY VALVE AS APPLIED TO A 4-CYLINDER INTERNAL COMBUSTION ENGINE

Railways and Their Accessories

GAGE FOR RAILWAY FROGS.—W. A. GOWRIE, San Pedro De Macoris, Dominican Republic, West Indies. The invention relates to gages designed to measure railway frogs, to give the catalogue angle of each frog, and the degree and radius of curve of turn-out from straight track of standard gage for which it is fitted. It is also designed for use in gaging tapering devcies of various kinds, and consists primarily of two forked members of defined though differing spans joined together by means of a rolled and spring returned tape bearing the scales for the particular use for which it is intended.



A TOP PLAN VIEW OF THE INVENTION IN OPERATIVE POSITION

RAILWAY GATE.—C. N. JAY, Marlow, Okla. The invention provides a guard which may be used wherever a barrier may be employed and is operable by means of a vertically sliding movement, it consists of a guard which is expansible and when projected into operative position, the members are moved outwardly at their upper ends into fan shape by means of springs, it is adapted to cover a relatively wide tract when projected and a small space when drawn into inoperative or folded position.

Pertaining to Recreation

FIGURE WHEELED TOY.—F. R. CARDINAL, 269 Main St., Holyoke, Mass. The invention relates to toys of the animated figure type actuated by a spring motor. It comprises a hollow body, a sound producer in bellows form, located in the forward portion of the body, having its movable upper side provided with a rearwardly projecting arm, a spring motor, a motor driven gear in the rear of the sound-producer, and a ratchet wheel mounted on the axis of the gear in alinement with the aforesaid arm. In using the toy it is only necessary to wind up the spring motor, the animal will walk, and produce sounds corresponding to the character of the animal simulated.

Pertaining to Vehicles

AUTOMOBILE BAGGAGE HOLDER.—S. HARA, Box 5, Coahuila, Mexico. The invention has for its object the provision of a baggage holder consisting of a frame adapted to be disposed vertically of the foot board between the front and rear fenders, means being provided for supporting the frame either at the outer side of the foot board, forming with the fenders and the shield a receptacle, or out of the way at the inner side of the foot board.

CONTROLLING PEDAL.—E. R. MARTINO, 666 Union St., Brooklyn, N. Y. The invention relates to controlling devices for automobiles. An object is to provide a construction whereby the clutch pedal and the gear shifting mechanism are combined in such a way that the clutch will always be out during the shifting of the gears. A further object is to provide a single lever operated by the foot, which by an up and down movement will throw out the clutch, and then by a back and forth movement shift the gears.

GREASE RETAINER.—F. JONES, 3002 Market St., Oakland, Cal. The invention relates to a contrivance which is designed to prevent the passage of grease from differential casing to the brake drums through the axle housing. The object is to provide a simple device which can be easily applied between the housing and axle near the bearing of the axle in the housing.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of patentee title of the invention, and date of this paper.

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New York State Barge Canal

(Concluded from page 57)

regard to these colors has been adopted, except that, upstream has been interpreted to mean proceeding away from the Atlantic Ocean, irrespective of the fact that in some instances such navigation will be downstream.

The bodies of water which have had to be provided with lighthouses are Oneida, Onondaga, Cayuga and Seneca lakes. The lighting of Oneida lake presented the most interesting problem, since it approached very nearly to marine conditions. There are numerous shoals in this lake, the shore is low and affords but few natural landmarks and the lake is somewhat subject, though infrequently, to sudden and severe storms. Three lighthouses mark the main courses, one at each end and one on an island not far from the western end. Two of the lamps display occulting white lights of 1,500 candle-power, visible for 15 miles, and the other a fixed red light of 1,000 candle-power, visible for about 10 miles.

It is fortunate that the people of New York State in the construction of their new canal have had the wisdom to avert the supreme weakness of nearly all American waterways—the lack of suitable terminals. When we realize that the entire success of a waterway may be subverted by monopolized terminals and also that the cost of loading and unloading is by far the largest part of the transportation charge, we begin to appreciate the importance of both terminals and their accompanying freight-handling devices.

It was eight years after the canal itself was authorized before the act was passed which provided for the terminals. It seems strange now that the projectors of the Barge Canal could have considered so lightly one of the most vitally important parts of the undertaking as not to have included it in the original act. However, the terminals were begun in time to have most of them ready at the completion of the entire canal.

At some fifty localities terminals have been or are being built. These places are scattered along all four branches of the canal and the adjoining lakes, which include Erie, Ontario, Champlain, Oneida, Onondaga, Cayuga and Seneca, besides those in New York city. There are doubtless many localities which should have terminals, but which cannot be supplied under the original appropriation. The Hudson River is in reality a part of the State system and the cities and villages south of Albany should have canal terminals, as also should additional villages on the canal itself. Also, New York city should have more, but here the State has entered the field so late that the acquisition of sites is very costly. There are certain sections of the business portion of Manhattan which should contain canal terminals as distributing centers, but which must go without them unless additional money becomes available for acquiring the sites.

If the pleas are complied with which have gone to the Federal authorities from many sources during the last few weeks, probably much shipping will be seen on the Barge Canal next season. But to accomplish this desideratum it seems almost imperative for the Government either to build boats or to aid in building them. The old boats are small and nearly worn out. New ones have not yet been built and now it is difficult for individuals to get labor and materials for constructing them. In our pressing need for additional transportation, it is sincerely to be hoped that the Government will hear and heed these calls.

The Barge canal is being built under the direction of Frank M. Williams, State Engineer and Surveyor, the immediate charge of construction being under Dwight B. La Du, Special Deputy State Engineer.

The Dye Problems of India

INDIA is trying to solve the problem of the lack of dyestuffs caused by the total disappearance of aniline and alizarine dyes, which used to be imported from Germany. In the absence of these chemical dyes naturally people turned to the old indigenous dyeing materials, mostly vegetable substances, with which marvels were worked in the olden days when the fabrics of India were of some account in the markets of the civilized world. But the defection of the Indian dyer from the natural indigenous dyes to the imported synthetic varieties is now being heavily paid for. Whatever may have been the cause in the past of the value of the natural dyes, the ability of the dyer to get good and commercially successful results from them, the art has apparently been lost. In exact measure to the whole-hearted and rapid way in which the synthetic dyes were taken up has been the rapidity with which the ancient dyeing art has been forgotten.

Nevertheless, there are hopes that the situation may be relieved. It has been said that in Madras there is hardly a single tree that grows that is not a source of a brilliant dye or of some substance that is almost indispensible in dyeing. In the Madras roadsides, for instance, there are coral-wood trees, the margosa, the tulip or portia tree, the jack-fruit tree, the causarina, the two wood-apples (Aegle marmelos and Feronia elephantium) to name only a few. In the Indian gardens the wealth of possible dyestuffs is even greater, for there we have the henna, the guava, the pomegranate, the Indian or bastard almond the Butea frondosa, whilst in the waste lands are found the acacias and madders, the dyeing uses of which have been known for generations.

The Pink Ball Worm in Texas

WHEN a Federal inspector, on September 8th last, discovered the larva of a pink boll worm at Hearne, Texas, a campaign of extermination was precipitated on the outcome of which depends the future of the cotton industry of the South, if not, indeed, the winning of the war, since cotton holds such an important place in the manufacture of munitions and clothing. Twenty-five entomologists rushed to the point of infestation. Though the pink boll worm was then found in but four fields, ten other fields were condemned. Four hundred and thirty-eight negroes from adjacent counties were brought in, one squad being assigned to pulling plants, the other to burning them. Sixty gallons of kerosene were applied to each heap at the outset, additional oil being added until the plant material was reduced to ashes. Entomologists were sent in groups of three to other mills, as the work at Hearne continued.

Notwithstanding all these precautions, pink boll worms have recently been found elsewhere, notably at Anahuac. The menace of this appearance is made evident when it is considered that the pest has been known to be responsible for the destruction of as high as 75 per cent of the Egyptian cotton crop and, together with the cotton boll weevil, 90 per cent of the Mexican yield. Emergency work undertaken to combat the invasion consists of scouting, destruction of plants in the field and safeguarding the seed and lint produced in infested territory. Thirty-four experts have been detailed to lead in the effort a force which is being added to from time to time. An army of several hundred negroes, with tents, stoves and other camp equipment, has been assembled from Beaumont, Houston and Galveston. When recruited to full strength, it will number 1,000. Three motor trucks and five automobiles have been provided to transport the men from field to field and to and from camps. Their work consists largely of chopping out plants, piling them together, and burning them, together with what trash can be picked up by hand.

Under the microscope, a specimen of the pink boll worm may be readily distinguished by the strong mandibles, as broad as long, with four stout, rather short teeth, the three lower ones pointed, the upper blunt; a fifth lower tooth is slightly indicated on the under side; one long and one shorter sets on the upper side near the lower edge. There are three pairs of normal thoracic feet; four pairs of abdominal prolegs with crotches of uniform size in an incomplete circle, opening outwardly; and prolegs with a transverse row of uniordinal hooks.

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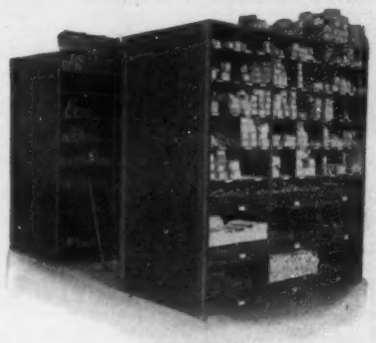

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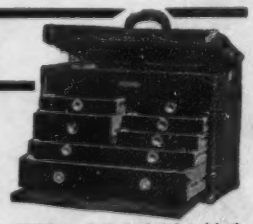

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NEW BOOKS, ETC.

FINANCIAL STATEMENTS MADE PLAIN. By Earl A. Saliers, Ph.D. New York: The Magazine of Wall Street, 1917. 16mo.; 96 pp. Price, $1.06 postpaid.

TRADING IN WHEAT. By Arthur Prill New York: The Magazine of Wall $1.06 postpaid.

YOU AND YOUR BROKER. By Robert L. Smitley. New York: The Magazine of Wall Street, 1917. 8vo.; 60 pp. Price, $1.04 postpaid.

Comparatively few investors know how to extract the meat from a financial statement, yet such knowledge might often safeguard their interests in no small degree. It is not necessary to be an accountant in order readily to understand at least the first few chapters of "Financial Statements Made Plain," to learn how to analyze the income account, the relation of assets to liabilities, and the functions of funds and reserves. Later chapters go more deeply into the subtilties of the subject. In "Trading in Wheat," Arthur Prill gives us the fundamentals of the business, discusses wheat supplies and price levels, sketches the routine of orders and their execution, and urges the necessity for definite campaign methods. "You and Your Broker" is a pamphlet written especially for investors and traders, in which the terms and methhods of brokerage are simply explained. It deals effectively with the questions of choosing a broker, the fair interest rate, the right way to give an order, the computation of margin, and much other information that the outsider not infrequently pays heavily for in acquiring.

THE PLATTSBURGH MANUAL. A Handbook for Military Training. By O. O. Ellis, Captain, United States Infantry, and E. B. Garey, Captain, United States Infantry. New York: The Century Co., 1917. 8vo.; 340 pp.; 165 illustrations, Price, $2 net.

No man in camp training, and no man who is looking forward to such training, can afford to ignore the aid extended to him in this already famous Manual. The general advice of the first chapter will save the rookie much of the annoyance due to ignorance of camp rules, habits, and equipment. Setting-up exercises, persisted in for some time before departure for training, will strengthen and render supple the body, and give it the endurance called for by the duties of military life; these exercises are illustrated by photographs, as are the salute and drill positions, and these illustrations show, side by side, the right and the wrong way of doing things. Evolutions by squads and companies, which are sure to seem intricate to the bewildered beginner, are so diagrammed and explained as to make all the ordinary changes in formation as plain as A, B, C. A most important chapter is that on fire superiority, in which this vital matter is considered under the aspects of direction, control and discipline. Whether it be saluting an officer or squeezing a trigger, the authors may be relied upon to give the greatest possible help in the simplest possible language; the recruit is told how to meet the strain of the practice march with the minimum of discomfort; the working of the Officers' Reserve Corps system is shown and the duties of its various sections are thoroughly detailed; while seven added chapters have such themes as the theory of security, attack and defense, signals and codes, and first aid. It is impossible to praise too highly the manner in which these competent instructors, Captains Ellis and Garey, have reduced such a mass of varied facts and information to its simplest terms; they have earned the gratitude not only of the recruit, but of the nation.

ORGANIC EVOLUTION. A Text-Book. By Richard Swann Lull, Ph.D., Professor of Vertebrate Paleontology in Yale University. New York: The Macmillan Company, 1917. 8vo; 748 pp.; illustrated. Price, $3.

This substantial work has a point of difference from the ordinary text on this subject, in that its author is a paleontologist, and bases his beliefs upon evidence with which writers on evolution are usually not so familiar. It emphasizes the human value of paleontology and makes a particular appeal to students of the past life of the earth. The evidences of evolution are carefully examined and its mechanism is presented in an orderly arrangement. Under ontogeny we find discussions of the life cycle, racial old age, and extinctions; under morphology and adaptations the work takes up such considerations as coloration and mimicry; parasitism and degeneracy; aquatic, scansorial and volant adaptations; and cave and deep-sea life; the section on paleontology begins with the nature and interpretation of fossils, and has much to say of the origin of vertebrates, the rise of reptiles, and the incursion of modernized mammals; the final chapters deal with the evolution of man as illuminated by ontogeny, morphology and paleontology; the whole work is enriched by fine full- page plates and by a galaxy of smaller illustrations. It constitutes an unusually good and comprehensive presentment of a subject an interest in which is everywhere and always coexistent with human life.

GLOSSARY OF AVIATION TERMS. Compiled by Lieut. Victor W. Pagé, A. S. C., U. S. R. and Lieut. Paul Montariol, French Flying Corps. New York: The Norman W. Henley Publishing Company, 1917. 8vo.; 94 pp.; illustrated. Price, $1.

Both French and English speaking aviators will find in this Glossary a very complete list of aviation terms, arranged under flying field terms, the plane, the engine, and tools and shop terms. The work is not a dictionary, and does not give definitions; but the illustrations, consisting of full-page plates and folders, are so detailed, each part bearing its technical name in both languages, that a deep knowledge of aviation is not necessary to a rapid mastery of the vocabulary. The English and French lists are elaborations upon those prepared for use in teaching classes at the Signal Corps Aviation School, Mineola, and they are admirably adapted to serve the purpose for which their compilers intended them—that is, closer cooperation and more intelligent discussion of aviation subjects between members of our overseas forces and their allies.

HOW TO LIVE AT THE FRONT. By Hector Macquarrie, B. A. Cantab, Second Lieutenant, Royal Field Artillery. Philadelphia and London: J. B. Lippincott Company, 1917. 8vo.; 269 pp.; illustrated. Price, $1.25 net.

Our boys who are preparing to go "over there" have in this volume a splendid opportunity to profit by the experience of a clean, straight-thinking officer who has been through it all himself. He wastes no time on what may be found in official textbooks, but drives directly at the problems that come with a new life and a strange environment, with association with the Poilu and the Tommy and, most particularly, with the difficulties and temptations that may come as a revelation to the American soldier himself. There are moral as well as physical dangers, and perhaps the most subtle of the former is the attitude of mind that is induced by the death-dealing and death-receiving atmosphere. Lieut. Macquarrie gives sound "tips for the American soldier" that will enable him to ameliorate conditions at the front, take proper care of his body, and teach him to fit into the machinery of which he is a cog. It also teaches him how to take care of his mind, to look through the red chaos of war to the saner aspects of peace, and to keep his balance and his ideals through all attacks and vicissitudes.

MAKING THE GRADE. By C. V. Mosby, M.D. St. Louis: The Highland Press, 1917. 8vo.; 145 pp. Price, $1.

The "grade" that Dr. Mosby refers to is the hill-road of success in life, and it is significant that he visions life as a climb toward success rather than a coast toward old age. He believes that it is within the reach of all to win, and his commonsense dissertation takes health and endurance as foundation stones, shows the proper use of such qualities as patience, courage and self-confidence, points the way to a correct estimation of values, and strives to inspire all ages and both sexes to get the best that is possible out of life. It is sound philosophy, shorn of all mysticism, in a garb adapted to everyday wear and allowing free play to the muscles of honest strength. The work is so written as to be just as interesting to the man who already has its principles by heart as to him who learns those principles for the first time.

HOW TO WRITE BUSINESS LETTERS. Edited by Walter K. Smart, Ph.D., in collaboration with the Editorial Staff of *System*. New York: A. W. Shaw Company. 8vo.; 160 pp. Price, 70 cents.

Only lately has it come to be realized that business correspondence is a highly developed art; perhaps this accounts for the fact that there are so many worthless books on the subject. Here is one that is really good—that it places the tone of the letter at the head of all other considerations is almost sufficient endorsement of the succeeding lessons. It emphasizes the importance of expressing old ideas in a new way; it gives examples of good and bad practice side by side; it deals specifically with inquiry and contract letters, complaint letters, collection and sales letters; the latter are so presented that the beginner immediately learns how to win attention at the start, how to develop one or more ideas in a short paragraph, how to employ the "whip" in the right place, how to make a compelling argument, and how to whet curiosity at the close.

SECRETS OF POLAR TRAVEL. By Robert E. Peary. New York: The Century Company, 1917. 8vo.; 313 pp.; 75 illustrations from photographs. Price, $2.50 net.

Those who read Rear Admiral Peary's "The North Pole" will remember that it hinted at a carefully-devised and rigidly tested system of exploration to which credit must be given for the successful culmination of his hopes. In this later work we find a complete exposition of that American resourcefulness which met difficulty after difficulty, and a revelation of the author as an inventor as well as an explorer. A case in point is the perfection of a method of icing the runners of sleds so that the ice would stay on, an achievement that meant faster travel with increased ease and a reduction in the loss of dogs. In cooking, in packing, in forced marching, ways were found to improve service and to bring the white goal a little nearer. We are shown the different stages in the building of a polar ship, the manner of picking the men that were to compose the party, the details of supplies and equipment, the difficulties of ice navigation, the vital importance of proper clothing, and the ways in which Eskimos and dogs were utilized. The romance that marks all supreme effort clings to the pages of this adventurous narrative and is enhanced by the striking photographs of its distinguished author, showing the ship, the men, arctic scenery and animals and, finally, the stars and stripes flying from the North Pole. The work provides the reader with parlor-car transportation through regions frozen yet teeming with animal life; best of all, he has the benefit of a guide who not only knows every league of the way, but who knows how to tell what he knows.

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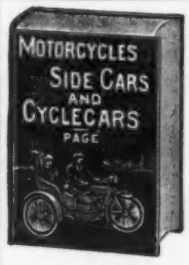

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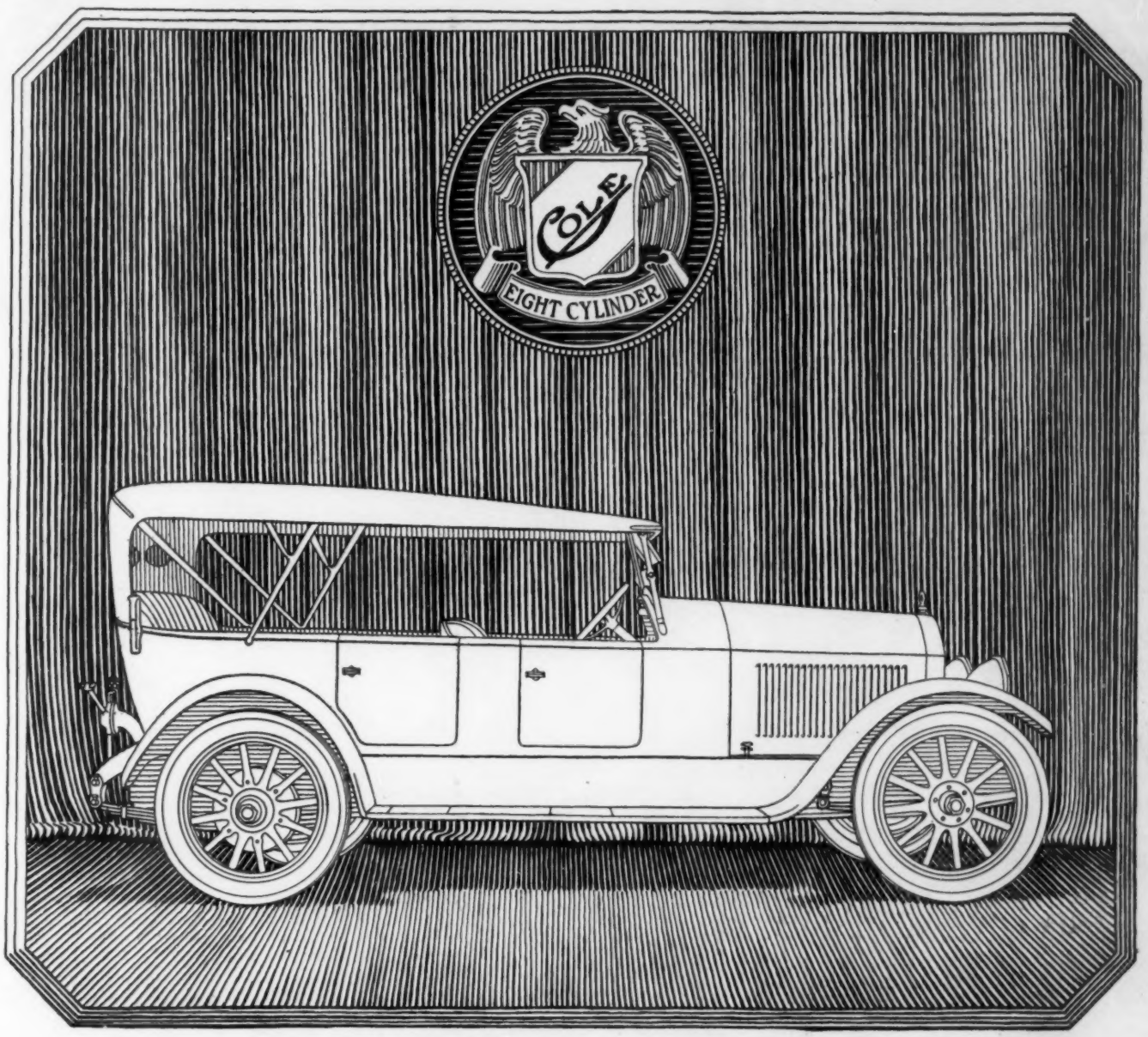

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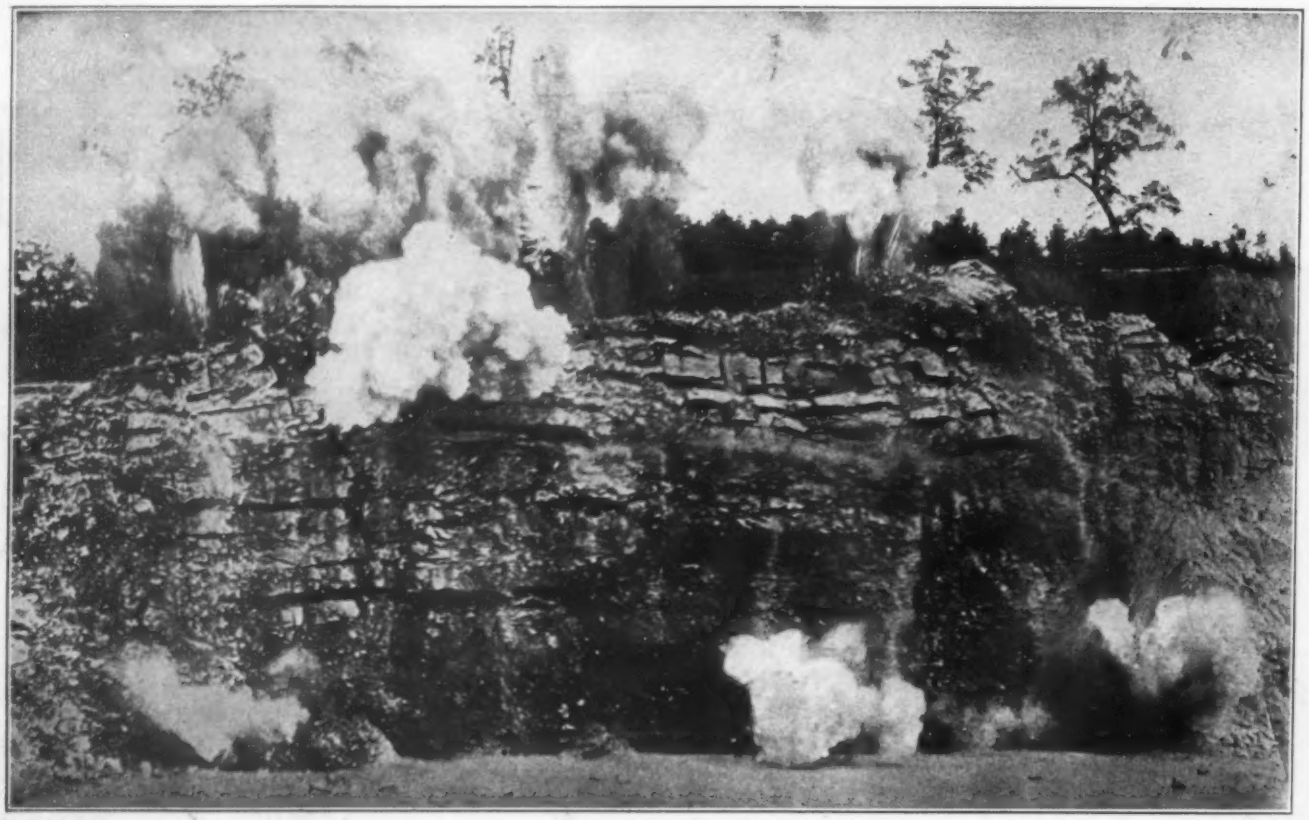

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